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## CHANGES IN POSTING AND LANDOWNER ATTITUDES IN NEW YORK STATE, 1963-1973<sup>1</sup>

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### ABSTRACT

Ten years of change in public recreational access to private lands in upstate New York was measured in 1972-73. The previous study of the nature, extent and reasons for posting served as a bench mark for this study. As in the original study, the work was divided into two phases. Phase I consisted of a field survey of road frontage posted, while Phase II was a questionnaire exploring the landowner's motivations in posting.

The field survey of 28 of the 100 towns represented in the original study showed that 29 per cent of all road frontage was posted in 1972 compared with 16 per cent in 1963. In Phase II, a 77 per cent response was obtained from mail questionnaires sent to 1,719 landowners in the 28 townships covered in the field survey. The questionnaire responses indicated that the proportion of rural acreage posted had increased during the 9-year period from 25 to 42 per cent. Regional data showed the greatest degree of posting to be in areas adjacent to metropolitan centers: 68 per cent in the lower Hudson River area adjacent to greater New York City; 59 per cent in Region 8 (including the greater Rochester area); and 42 per cent in Region 4 (including the Albany-Schenectady-Troy metropolitan center). Regions 5 and 6 in northern New York showed the lowest percentage of private land posted with 25 and 27 per cent, respectively. The remaining upstate areas were intermediate with 34 and 39 per cent of private acreage posted.

<sup>1</sup>A contribution of the New York Cooperative Wildlife Research Unit: Cornell University, New York State Department of Environmental Conservation, U.S. Fish and Wildlife Service and the Wildlife Management Institute co-operating. The authors wish to express their gratitude to the Wildlife Management Institute and the New York State Conservation Council Foundation for their generous support of this study. The work was also supported in part by Federal Aid in Fish and Wildlife Restoration funds (Project W-127-R). We are indebted to many people for their contributions to various parts of the study. Herbert Doig and Vernon Husek are acknowledged for their help through the Division of Fish and Wildlife of the State Department of Environmental Conservation. We are particularly grateful to the many conservation officers who gave generously of their time and energy in gathering the field data for Phase I of the work. We also thank the regional directors of the Department for their support of our efforts. Finally, we wish to thank Daniel Miller for his assistance with all phases of the study. Harlan Brumsted and Alexander Dickson were also extremely helpful in carrying the results of the study to the sportsmen, landowners and recreational public.

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Of the parcels reported posted on the mail questionnaire responses, 85 per cent were posted by the owners themselves, and an additional 3 per cent were posted by tenants. Special-interest or second-party posting accounted for the remaining 12 per cent.

Motivations for posting were strongly conditioned by the landowners' previous experience with recreationists. Of those who posted, 55 per cent reported having had bad experiences with recreationists. Of these negative encounters, 56 per cent were with hunters, 26 per cent with snowmobilers, 7 per cent with fishermen and 11 per cent with other trespassers not necessarily recreationists. Posting and nonposting landowners held similar attitudes about the quality of hunting and snowmobiling as recreational activities. They differed sharply, however, in their attitudes about the behavior of hunters and snowmobilers; those who posted generally felt these recreationists to be irresponsible, while those who did not post believed most hunters and snowmobilers were responsible. Although hunters have historically been the principal target of posting signs, landowners are now more negative toward snowmobilers than hunters in their attitudes.

Stepwise multiple regression analysis of the factors associated with posting revealed that only 62 per cent of the variance for the towns studied could be accounted for by independent variables such as population density, population mobility, age, education and income structure, distance from nearest metropolitan center, property value, etc. Of the independent variables on which data were available, residence in a metropolitan center was the most important in explaining the amount of posting; education level and property value per capita were also positively correlated with posting. The authors believe that the 38 per cent of the variance not accounted for is largely explained by the landowners' negative encounters with recreationists and other trespassers.

Although the demand for recreational use of private lands has become a year-around one, most landowners, at the time of this survey, did not object to the density or frequency of recreationists *per se*. The major problem continued to be the attitude of the landowners toward the behavior of the recreationists. Possible solutions to some of these problems are discussed.

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In 1962, growing concern with the problem of public access to private land stimulated the newly formed New York Cooperative Wildlife Research Unit to undertake a statewide study of the nature, extent and reasons for posting private land (Waldbauer, 1966). A sample of 100 towns were studied in Waldbauer's survey. They made up 12.1 per cent of the total acreage of the 764 upstate towns with populations of less than 150 per square mile. The results showed that, in 1963, only 25 per cent<sup>3</sup> of the area in private ownership was posted. In most parts of upstate New York, there was abundant opportunity for recreation on private land in 1963.

Despite these optimistic findings, a second phase of Waldbauer's work indicated tension and conflict between landowner and recreationist. He interviewed a random selection of 361 landowners from the 4,176 owners who had posted their holdings. Posting landowners most often indicated that an unfavorable experience with hunters was the underlying cause for their decision to post. Waldbauer concluded that any easing of these tensions would require improvement in hunter behavior.

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<sup>3</sup>Waldbauer's paper gave this as 26 per cent. However, adjustment for a slight error discovered when the data were reexamined makes the correct figure 25 per cent.

As the tenth anniversary of Waldbauer's study approached, many signs indicated that posting on private lands was rapidly increasing. Studies of Broome County landowners indicated that posting increased from 18 per cent in 1959-60 to 47 per cent in 1970 (Wilkins, 1959; Wilkins and Erickson, 1971). Other data gathered by Wilkins and Erickson for Tompkins and Yates Counties were more difficult to compare directly with Waldbauer's findings, but they nevertheless indicated a sharp rise in the amount of private land posted against public trespass. This and other evidence indicated that a resurvey, patterned after Waldbauer's bench mark study, would be very timely. The Wildlife Management Institute catalyzed this decision by announcing a nationwide program of research grants to be awarded to agencies submitting the most promising socio-economic study proposals. The New York Unit was fortunate in obtaining one of these grants.

This paper was written in 1974 immediately after the study was completed. Statements in the present tense should be read in that context.—Editor

## BACKGROUND

In the past 10 years, a number of changes and shifts in population and land use have occurred which have had, and will continue to have, a profound influence on the landowner-recreationist relationship, both in New York State and nationwide. Related legal changes have also occurred as a result of increased land-use pressures by recreationists. A number of these changes and shifts provide important background to the current study.

## TRESPASS AND POSTING PROBLEMS IN OTHER STATES

Available evidence suggests that posting and landowner-recreationist conflicts have reached moderate levels throughout much of the eastern half of the United States. The only reports to suggest low levels of posting have come from northern New England. A New Hampshire study showed that only 14 per cent of that state's landowners posted, circa 1970 (New Hampshire Fish and Game Department, 1971). The more highly educated and the more distant absentee landowners posted most frequently.

Vermont wardens estimated that 395,492 acres of land (about 6 per cent of the state) was posted in 1963, representing a 137 per cent increase over the 1955 level (Bevins, 1964). A new law requiring posted lands to be registered with the local town clerk reduced the amount of such lands

to only 1.6 per cent in 1969. In 1973, a personal interview study of 1,042 landowners and recreationists showed that 40 per cent of respondents indicated some type of outdoor recreation conflict; however, over half the reported conflicts were between various recreational groups (e.g., fishermen vs. waterskiers). Nineteen per cent of rural landowners reported conflicts with recreationists during the 1972-73 season (University of Vermont, 1974).

Posting incidence in other states neighboring New York is either not documented statewide or has not been measured since 1960. Nevertheless, the evidence suggests that posting may have reached moderate levels by the current decade. In Massachusetts, 27 per cent of private lands were posted in 1956 (Larson, 1959), slightly higher than the level in New York seven years later. In Pennsylvania, a study of Sullivan, Huntingdon and York Counties in 1963 showed the proportions of total acreage posted to be 32, 24 and 43 per cent, respectively (Barclay, 1965). Finally, a survey of Ohio farmers in 1963 showed that 29 per cent of the respondents had posted against hunters (Ohio Division of Wildlife, 1965).

Similar data are available for three more distant states. In West Virginia, a study showed that in 1965 about 29 per cent of that state's landowners posted at some time during the year (McIntosh, 1967). In neighboring Virginia, 39 per cent of study respondents posted in 1972, and "serious restriction of access to private land for hunting and fishing was found, especially in the urban and mixed urban-rural counties" (Virginia Cooperative Wildlife Research Unit, 1973). Finally, in certain Michigan counties, moderate levels of posting were evident by the 1950's (Outdoor Recreation Resources Review Commission, 1962), but these studies have not been updated since 1960. In 1960, 18 per cent of wildland acreage in a 34-county area of central Michigan were "under fence or posted". In eight counties the proportion was at least 25 per cent, ranging upward to 63.7 per cent for Alpena County.

#### CHANGES IN HUMAN POPULATION SINCE 1963

Population changes in New York State during the 10-year period covered by the study were largely a continuation of trends that were apparent in the 1960 census. The State's total population continued to grow, but the rate of growth was less than the national average. In 1960, New York's total population of 16.8 million represented 9.4 per cent of the total for the country as a whole; by 1970, it had increased to 17.3 million but represented only 9.0 per cent of the national total. Nevertheless, during the 10-year period, the increase in potential recreational users was equivalent to approximately double the total population of Montana.

Population shifts within the State's boundaries were even more dynamic during the 1960's. Figure 1, when compared with Figure 3 of Wald-

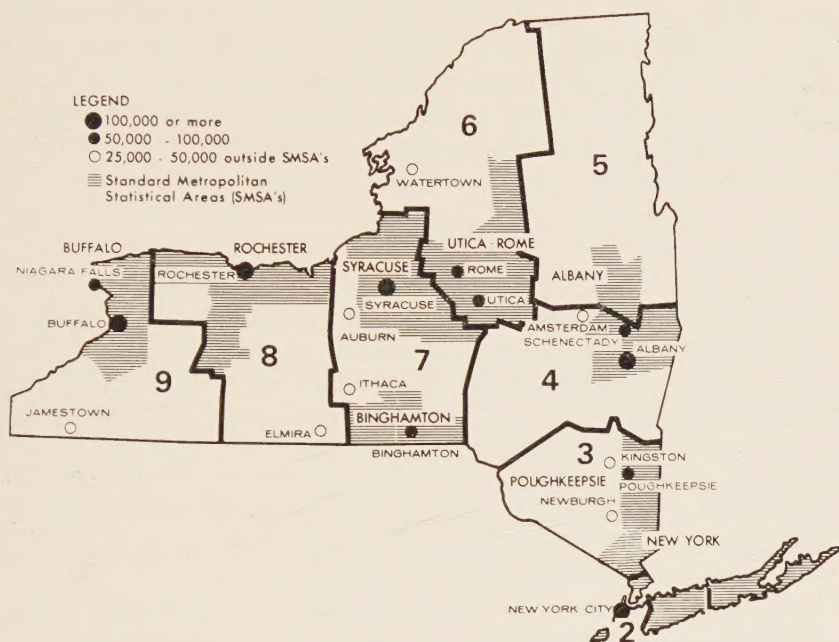


Figure 1. Principal population centers in relation to administrative regions of Department of Environmental Conservation.

bauer (1966), indicates the increasingly metropolitan character of the Lower Hudson (Region 3) and western Finger Lakes (Region 8) areas.<sup>4</sup> The continued growth of the greater New York and Rochester metropolitan areas was responsible for most of this increase. Dutchess and Putnam Counties have been given "standard metropolitan statistical area" (SMSA) designation (according to classification of the U.S. Bureau of the Census) since 1970. In contrast, the rural St. Lawrence and Tug Hill areas (Region 6) showed a 24 per cent decline in population density during the 10-year period. Regions 5 and 7 showed slight population increases of 4 and 7 per cent, respectively. The increase in Region 7 was largely the result of the growth of the greater Syracuse and Binghamton metropolitan areas. Lying at the far western end of the State, Region 9 showed no change over-all; however, further study of population changes in towns and cities within the region demonstrated a pattern of population shift that is typical of all of the State's eight metropolitan areas. As the city of Buffalo declined in population during the 1960's, all of the townships within commuting distance showed a corresponding population increase. This population shift has reduced the opportunities for

<sup>4</sup>Numerical designation of the administrative regions of the Department of Environmental Conservation are those currently in use. They differ from those in effect at the time of Waldbauer's study.

public recreation on private land. The very presence of scattered new homes throughout many of these townships restricts the use of firearms. Moreover, State officials and sportsmen are concerned that these newly arrived suburbanites may be less tolerant of public use of their property than were the former agricultural owners. This concern was investigated in the present study.

#### CHANGES IN LAND USE AND OWNERSHIP

Many factors have been operating during the past decade to bring about sharp changes in land use and land ownership in New York State. The shift of city dwellers to suburban locations can be seen as an outward growth along major traffic arteries from population centers. This is most conspicuous in the major metropolitan areas, but it is also characteristic of many smaller urban centers. The combination of this expansion and the legal limitations on the use of firearms within 500 feet of a dwelling has resulted in the loss, for potential recreational use, of much open land adjacent to urban centers; some of these lands contain ideal hunting coverts.

Fortunately, the loss in private agricultural land near urban centers is offset by another remarkable trend which has been characteristic of upstate New York for the past 50 years. Figure 2 depicts the decrease in total farm acreage that has taken place through the most recent decade. Total farm acreage declined from 20.6 million acres in 1920 to 10.2 million acres in 1969 (U.S. Bureau of the Census, 1972a). The average rate of this decline exceeded 208,000 acres per year. To visualize this acreage more clearly, imagine driving along the road looking  $\frac{1}{2}$  mile on both

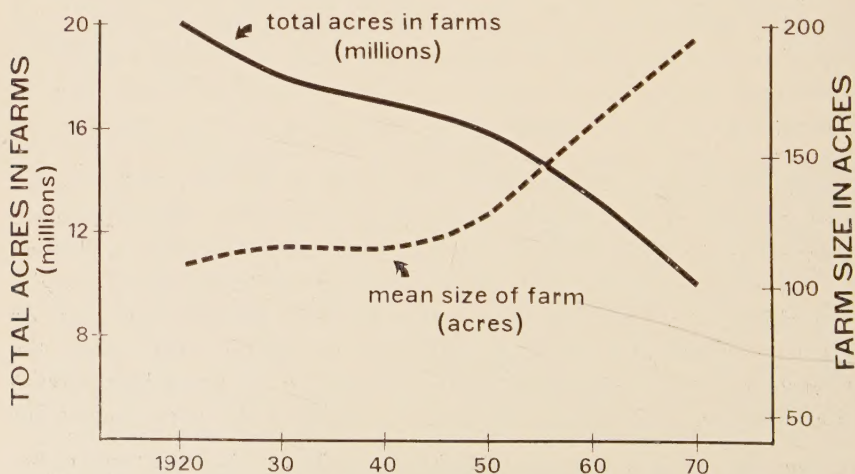


Figure 2. Total acreage in farmland and mean size of farm units, 1920 to 1970.

sides. One would have to drive over 300 miles to see the equivalent of the land that had reverted during the previous year. Fortunately, the newly abandoned land does not occur in a continuous strip, but rather as scattered patches of old-field habitat. The newly reverted land tends to have a regional pattern, but approaches a random distribution locally. The mixture of active farm land, newly reverted old fields and various stages of earlier old-field habitats creates ideal conditions for a variety and abundance of wildlife.

Two factors tend to limit the usefulness of such newly reverted fields to hunters. First, they tend to pass rather rapidly into early forest succession. Bump (1950) found that open land on Connecticut Hill (15 miles southwest of Ithaca, N.Y.) decreased by 89.9 per cent from 1928 to 1948. With the closing of the young forest canopy, the old-field habitats lose much of their attractiveness and productivity for wildlife populations. The second factor is the purchase of such areas by residents of nearby urban centers. A New Hampshire study showed that these new owners, who often use their property as weekend vacation sites, are not as likely to open their lands for public recreational use as were the former farm owners (New Hampshire Fish and Game Department, 1971).

In summary, many of the changes in land use during the 1960's tended to relieve the pressure of continued population growth. In the next 10 years, we should be wary of the expectation that newly reverted land will offer a similar amount of new wildlife habitat. While U.S. Census of Agriculture data for 1974 are not yet available, there are indications that the rate of agricultural land reversion may be dropping sharply.

#### CHANGES IN RECREATIONAL INTEREST SINCE 1963

During the interval between the two surveys, a number of changes occurred that have affected the interests of recreationists and the reactions of landowners. Notable among these are the rise of the snowmobile, and increased affluence and leisure.

**THE RISE OF THE SNOWMOBILE** In addition to differences in population levels in parts of rural New York and turnovers in land use and ownership, both the numbers of recreationists and the activities they engage in have undergone tremendous changes since the Waldbauer study. Undoubtedly the greatest cause of this recreational change has been the technological response to the increased leisure market of the mid-1960's which resulted in the development of the snowmobile, trail bike and other all-terrain vehicles.

Since the snowmobile's commercial debut in 1959, when 259 vehicles were sold in North America, the number of vehicles sold across the continent skyrocketed to some 572,000 in 1971. The total number in opera-

tion (circa 1972) was estimated to exceed 2 million (Baldwin and Stoddard, 1973). In New York, snowmobile registration and licensing has only been in effect since 1971. In that year, 135,487 vehicles were registered, and in 1972 the number increased 17 per cent to 158,459. In 1972, Oneida County, where 10,763 were registered of which 10,578 were reported as used primarily in that county, was easily the State's leader in both categories. The remaining nine of the top 10 counties in which snowmobiles were registered for primary use in 1972 were Onondaga, St. Lawrence, Erie, Oswego, Monroe, Jefferson, Saratoga, Herkimer and Wayne, in that order (New York State Office of Parks and Recreation, 1973).

It is notable that eight of the top 10 counties in which snowmobilers registered their machines for primary use were associated with standard metropolitan statistical areas. A study by Hill (1971) of snowmobilers in Cortland and Onondaga Counties showed that about half of the Onondaga County operators lived in undeveloped parts of the county, about 10 per cent lived in villages and the remaining 40 per cent lived in Syracuse. In adjacent Cortland County, almost three-fourths were rural residents. Thus, while the majority of New York's snowmobile users appear to be rural residents (from examination of registration data), moderate sales of snowmobiles have occurred within the metropolitan centers, and one would expect snowmobiling pressure to be placed on undeveloped areas in and surrounding the upstate metropolitan centers. With higher winter temperatures and less snowfall in the New York City area, less than 900 snowmobiles were reported by the Office of Parks and Recreation as registered by New York City-Long Island residents in 1972.

Hill's findings of snowmobiler traits and use patterns add strength to the hypothesis that rural landowners, especially those surrounding urban centers, were feeling pressure from snowmobile use. The majority of snowmobilers owned more than one vehicle and preferred to travel in small groups. About three-fourths of total snowmobiling was concentrated in weekends, and almost half occurred at night. Over half the sample preferred trails of at least 10 miles in length. Despite substantial public acreage available to snowmobiles and the fact that over 80 per cent of all snowmobiling was done in the county of residence, the majority of study respondents indicated that most of their snowmobiling occurred on private lands which they neither owned nor leased.

While trail bikes are common to much of the rural landscape, they are not registered and there are few data on their numbers or user traits.

**INCREASED AFFLUENCE AND LEISURE EXPECTATIONS**      Combinations of increasing urban populations, working patterns and increased income are most frequently cited for the growth in outdoor recreation during the 1960's. Many studies of the reasons for outdoor recreation participa-

tion cite diversion from the working-living environment as important. For some trades, the work week has declined to 35 hours. For many other occupations, the duration of the work week in total hours changed little during the 1960's and early 1970's, but work schedules changed to allow more blocks of leisure time. Some plants have gone to four-day work weeks. Several holidays have been changed to form three-day weekends. Finally, while research data are not available, the authors feel that paid vacations are now more frequent and their duration longer than a decade ago.

Perhaps the catalyst of rising recreational participation has been increased affluence. Inflation aside, median family income rose, in constant 1971 dollars, from \$8,461 in 1961 to \$11,020 in 1971 in the Northeast (U.S. Bureau of the Census, 1972b), an increase of 30 per cent. When one considers the increase in fringe-benefit packages accompanying jobs, the increase in disposable income for recreation may have increased even more.

Manufacturers of leisure equipment were quick to respond to this situation. This era saw the introduction and rapid increase in production of camping vehicles, gear and accessories. Improvements were made in fishing tackle and boats. Hiking, backpacking and cross-country skiing began to increase in prominence. Finally, as previously mentioned, off-road vehicles added a completely new dimension to the use of rural lands.

#### LEGAL CHANGES SINCE 1963

An excellent review of the evolution of laws related to posting in New York through 1962 was given by Waldbauer (1966). While most of the important legislation that directly concerns the activities of hunting and fishing on private lands, including the Fish and Wildlife Management Act of 1957 allowing the State to negotiate access privileges with private landowners, was enacted prior to 1963, two notable legislative changes have occurred in the past 10 years. The first extends the immunity of private landowners from liability, while the second makes it illegal to cross barricaded property boundaries.

A provision of the recodified Fish and Game Law of 1956, which was subsequently incorporated into the General Obligations Law as Section 9-103, stipulated that whether his lands were posted or not, a landowner owed no duty to keep the premises safe for entry or use by others for hunting, trapping, fishing or dog training, provided no fee was charged. This law has been broadened by five amendments between 1965 and 1972. In its present form, Section 9-103 extends the list of recreational activities, for which the landowner owes no duty to keep his premises safe, to include hiking, horseback riding, bicycle riding, and motorized vehicle operation for recreational purposes.

Section 9-103 further states that, with the exception of "willful or malicious" failure to guard or warn against dangerous conditions, structures or uses of his property, a landowner owes no duty to warn such recreationists of potential dangers on his property. In addition, this section, at least by inference, allows the landowner to receive compensation from the State or federal government without limiting his immunity from liability by stipulating that it does not limit the liability that would otherwise exist where permission to pursue any of the enumerated activities was granted for a consideration "other than the consideration, if any, paid to said landowner by the state or federal government".

Legislation further limiting the use of private property by others for any purpose was enacted in 1965 as Section 140.10 of the Penal Law. This provision makes one guilty of third degree trespass, a Class B misdemeanor, if he "knowingly enters or remains unlawfully in a building or upon real property which is fenced or otherwise enclosed in a manner designed to exclude intruders". A commentary (McKinney's Consolidated Laws of New York, 1967) notes that, because of the wording of the legislation, the burden of proof is on the landowner pressing charges to show (1) that the intruder knowingly entered or remained unlawfully and (2) that the property was fenced or enclosed in a manner "designed to exclude intruders". The commentators suggest that, on the one hand, an 8-foot fence topped with barbed wire is obviously designed to prevent intruders, while 2-foot shrubbery, on the other hand, might be interpreted as more decorative than protective.

In addition to affording landowners with additional protection, one effect of Section 140.10 has been to provide the Department's Division of Law Enforcement with more assistance from the State Police and county sheriffs' offices who enforce the Penal Law. As the legislation has become better known, landowners faced with recreational trespass within fenced lands call traditional law enforcement personnel more frequently, relieving the Department of some cases of this type.

These legal changes reflect the socio-economic and demographic changes and the shifts in land use that have taken place since the 1963 posting study by Waldbauer (1966). Considering these rather massive shifts and their likely impact on the demand for, and availability of, private lands for recreation, an update of posting incidence and related landowner attitudes is particularly timely.

#### METHODS AND PROCEDURES

Since a major objective was to measure changes in levels of posting with time, it was immediately decided that the investigators would examine the same towns and use methods as consistent as possible with those of Waldbauer (1966). This further dictated that each adminis-

trative region would comprise a sampling stratum and that the town would be the sampling unit. The work was done in 1972-73.

Following Waldbauer's plan of investigation, the study was divided into two phases in which different methods were used. The objectives of each phase were as follows.

#### Phase I — Field Survey of Road Frontage

1. To determine the amount of road frontage posted in rural New York State and to determine the amount of change since 1963.
2. To estimate the current rate of posting.
3. To analyze the messages on posting signs as an outward expression of landowner intent.

#### Phase II — Questionnaire Survey of Landowners

1. To determine why owners post (or do not post) their lands and how these reasons differ from those given by landowners in 1963.
2. To determine the attitudes of landowners toward hunting, snowmobiling and various circumstances relating to public access to lands.
3. To obtain some measure of the demands currently placed upon landowners for recreational use of their lands by the general public.
4. To obtain a current estimate of the amount of acreage posted.

#### SAMPLING PROCEDURES

Waldbauer's "universe" (i.e., the total group considered) comprised all towns in upstate New York that had a 1960 population density of less than 150 persons per square mile. That universe contained 764 of a total of 919 upstate towns, and 100 were chosen for study. It was his judgment that towns of greater population than 150 per square mile were generally located near cities and offered little hunting and fishing opportunity.

In the current study it became apparent that the Department's conservation officers did not have sufficient time to make a field survey of 100 towns as was done in 1963. Time and financial constraints of coordinating Phase I and Phase II dictated that a maximum of four towns would be chosen for each of the seven upstate administrative regions (Regions 3 to 9). To make the towns selected as representative as possible of each region and the State as a whole, it was decided that no two towns would fall within the same county. Following this procedure, a conditional stratified random sample comprising 28 of the 100 towns studied by Waldbauer was selected (Figure 3).

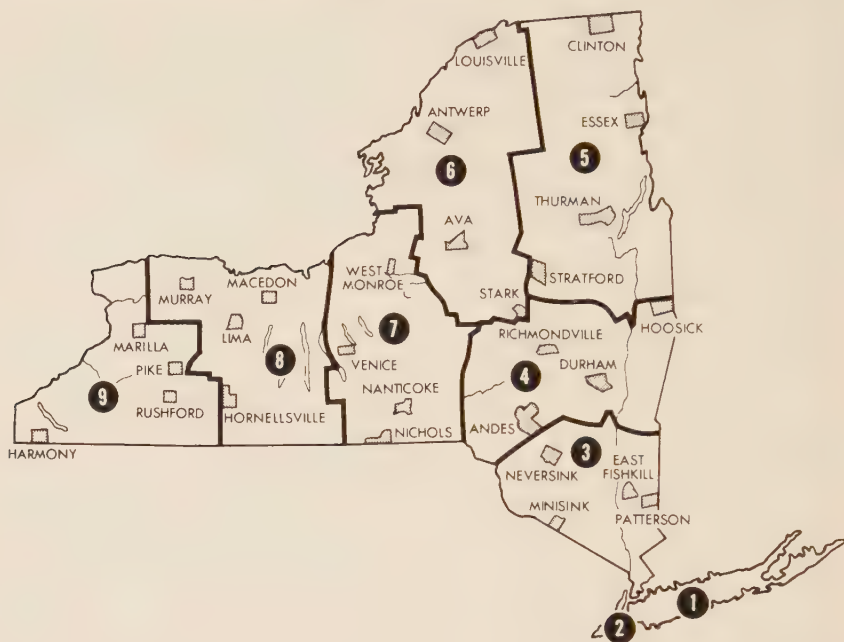


Figure 3. Towns sampled in posting study in relation to administrative regions of Department of Environmental Conservation.

With respect to Phase II, the population of interest was defined to be private owners of at least 10 acres. The combination of manageable sample size, needed sample size for regional deductions, and available funds determined that a 25 per cent sample would be drawn in each of the 28 towns selected for Phase I. Names and addresses of landowners were obtained from records in the offices of the county clerks. Most clerks had an index of property owners, but three had properties organized by parcel. For consistency, and to avoid the bias of incurring a higher probability of sampling owners holding several parcels, a list of landowners holding at least 10 acres was compiled for these three towns.

A systematic sampling scheme with a random start was used; enumerators randomly chose a starting number from one to four and then recorded the name and address of each fourth landowner holding at least 10 acres in the town. Thus, each such landowner had an equal probability of being included in the study, regardless of the number of acres or parcels he owned.

#### IMPLEMENTATION

The manner in which the actual surveys were carried on is described separately for the two phases of the study.

**FIELD SURVEY** For each town in the sample, a local conservation officer or a research technician carried out the field survey. Aided by county road maps, he traversed all public roads in the town and recorded the total road mileage as well as the road-front mileage of each posted parcel. A separate field survey form was completed for each posted parcel on which were noted the location of the parcel, whether it was posted by the owner, a sportsmen's group or another party, and the message on the sign. For the purposes of this study, a parcel was considered posted if one or more legible posting signs were found. Whereas the Waldbauer study focused considerable attention on the legality of posting signs, the focus of this study was to determine or deduce landowner intent.

In addition to needing information about hunting accessibility and the type of signs used (whether they prohibited all trespass or trespass for specific purposes only), an important reason for carrying on Phase I was to make a direct comparison of 1963 and 1972 posting rates, using identical techniques. Thus, except for deleting some items in the previous survey that did not fit current objectives, the 1972 study was run in identical fashion and at the same time of year as that in 1963.

**MAIL QUESTIONNAIRE** An attractive 4 x 9-inch mail questionnaire with an orange cover was designed for Phase II of the survey. That size was chosen because it would fit into a large business-size envelope. The back of the questionnaire contained the return address and postage. The inside back cover contained a folded-over gummed label for sealing the questionnaire upon completion.

Questions were designed to gain maximum information with a minimal amount of writing on the part of the respondent. Except for categorized questions allowing write-in "other" choices, only one open-ended question was used. Two rectangular arrays were developed to allow respondents to indicate whom they would allow to use their lands for various recreational activities and their reasons for posting by type of recreationist.

An important part of the survey concerned gauging landowner attitudes toward hunting and snowmobiling as legitimate recreational activities and toward these recreationists. Attitudes toward possession of firearms, toward opening private lands to the public for recreation and toward proper private-public responsibility for management of private lands were also sought. These attitudes were measured by a variation of the Thurstone equal-appearing interval continuum (Edwards, 1957). Each attitude sought was conceptually manipulated so that responses could be placed on a continuum. For each item, four viewpoints—strongly positive, mildly positive, mildly negative and strongly negative—were constructed. Landowners were asked to check the choice that best

indicated their feelings. A neutral or undecided alternative was not included because we wanted respondents to take a position, and we felt they were sufficiently experienced on these topics to do so. Attitude choices were pretested and revised to assure a reasonable "space" between continuum options and to assure that responses to each item could truly be placed on one continuum.

The 25 per cent systematic sampling procedure produced a total sample of 1,761 rural landowners, each of whom was sent a questionnaire on November 7, 1972. A first reminder notice was mailed one week after this date, a second reminder with accompanying questionnaire two weeks later, and a final reminder two weeks after the second follow-up. A total of 110 questionnaires were initially not deliverable. Appraisers were contacted for new addresses, and these were obtained for 91 landowners, of which 68 proved deliverable. Of the 1,719 questionnaires finally delivered (98 per cent of the sampling frame), 1,320 (77 per cent) were returned. However, 161 of these either indicated that the landowners no longer held title to the property or were not sufficiently completed to be usable. Thus 1,159 (66 per cent) of the original sampling frame returned usable questionnaires.

A telephone survey was designed for a sample of the nonrespondents to determine whether they differed from the respondents in regard to acreage held, whether they posted, whether they allowed hunting or snowmobiling, and their age and occupation. From the 399 nonrespondents, a sample of 272 was selected. For these, 137 telephone numbers were found, 10 numbers were unlisted and no number was found for 125. Of the 137 landowners whose phone numbers were found, 88 were reachable and interviewed. The remainder did not answer on at least six attempts, made on evenings and weekends as well as weekdays.

Since it was possible to interview only one-third of the nonrespondent sampling frame, it is uncertain whether those contacted were representative of all nonrespondents with respect to characteristics of concern to this study. However, information from those contacted, who constituted 22 per cent of all the nonrespondents, indicated few substantial differences between respondents and nonrespondents. Differences in size of holding, acreage posted, propensity to post, whether hunting was allowed and age were not statistically significant at the 0.05 level of confidence. Compared with the respondent sample, the nonrespondent sample contained about 50 per cent more farmers and only half the proportion of professional-technical workers. There were no significant variations in the two samples with respect to other occupational categories. Part of the reason for the higher representation of farmers in the nonrespondent sample is probably that farm families are more likely than non-farm families to be at home in winter and to be reachable by phone.

Thus, considering the high rate of return and the absence of marked differences between the respondent and nonrespondent samples, data presented in the findings are treated with the assumption that they contain no important sampling biases.

### FINDINGS

Of the 28 towns sampled, only East Fishkill in Dutchess County had a 1970 population density greater than 150 per square mile, and only eight towns had population densities greater than 50 per square mile (Figure 4). Of the 25 towns sampled whose boundaries were unchanged



Figure 4. Relative 1970 population levels of towns sampled and location of towns in relation to metropolitan centers.

from 1960 to 1970, 11 decreased in population and 10 others increased by less than 10 persons per square mile. While the State's metropolitan and other urban centers increased very significantly during this decade, the sample towns increased by an average of only 5 per cent. A regional summary of these population changes is shown in Table 1.

### POSTING OF ROAD FRONTAGE

For the 28 towns studied, a total of 1,135 miles of road frontage were posted in 1972 compared with only 698 miles in 1963, an increase of 63

TABLE 1. CHANGES BETWEEN 1960 AND 1970 IN POPULATION DENSITIES OF TOWNS SAMPLED, BY REGION

| Region | Population per square mile |      | Change<br>(per cent)* |
|--------|----------------------------|------|-----------------------|
|        | 1960                       | 1970 |                       |
| 3      | 63.1                       | 80.9 | +28                   |
| 4      | 34.0                       | 30.2 | -11                   |
| 5      | 12.6                       | 12.6 | 0                     |
| 6      | 23.8                       | 22.0 | -8                    |
| 7      | 40.7                       | 44.4 | +9                    |
| 8      | 69.4                       | 76.2 | +10                   |
| 9      | 44.1                       | 48.6 | +10                   |
| Mean   | 41.1                       | 45.0 | +10                   |

\* Expressed as percentage of 1960 population.

TABLE 2. RELATIVE PERCENTAGES OF ROAD FRONTAGE POSTED IN 1963 AND 1972, BY REGION

| Region | Road frontage posted |      | Net<br>increase |
|--------|----------------------|------|-----------------|
|        | 1963                 | 1972 |                 |
| 3      | 52                   | 58   | 6               |
| 4      | 11                   | 39   | 28              |
| 5      | 4                    | 11   | 7               |
| 6      | 4                    | 16   | 12              |
| 7      | 10                   | 25   | 15              |
| 8      | 25                   | 26   | 1               |
| 9      | 14                   | 18   | 4               |
| Mean   | 16                   | 29   | 13              |

per cent in 9 years. Whereas 29 per cent of all road frontage was posted in 1972, only 16 per cent had been posted in 1963 (Table 2).

Road-frontage data were not further analyzed as to rate of posting because they reflect increase in posting only and not the decrease in huntable acreage in New York. The Waldbauer study did not identify road-front miles that were not posted, yet not huntable due to residential, commercial or industrial areas not within city or village limits (in New York it is, in general, illegal to hunt within 500 feet of a building or dwelling). Due to the policy of following methods similar to those of the 1963 study for purposes of comparison, such frontage was not separated from other unposted road frontage in the present study.

Data for road frontage posted showed that a large bias may be introduced into interpretations, based on changes in frontage posted over time, for rural towns near urban areas because it is in such towns that residential, commercial and industrial areas would be most rapidly increasing. These data showed a sizable decrease (10 per cent or more) in the amount of road frontage posted for four towns, all in areas of rapidly expanding population: East Fishkill, Patterson and Durham in southeastern New York, and Marilla in the Buffalo SMSA. While there

may be fewer posting signs in these four towns now than in 1963, it is very probable that there is less access to hunting areas, and less huntable acreage.

Upon being informed by conservation officers in southeastern New York that this bias had been introduced, the State's Land Use and Natural Resources Inventory, which catalogues land use by square-kilometer cells on computer disks, was examined in conjunction with aerial photographs in an attempt to deduce the magnitude of the bias. Factors were derived to convert hectares of various classes of residential housing density and residential and commercial strip development to road-front miles. For 1967, the year of the inventory, it is estimated that residential and commercial development occupied 62 of 223 frontage miles in the Town of East Fishkill, 40 of 94 miles in Patterson, 24 of 227 miles in Durham and 21 of 92 miles in Marilla. This development frontage likely has increased greatly since 1967.

Thus, the important conclusion from Phase I about the degree of posting is that, despite this bias toward underestimating the amount of change, posted road frontage increased by 63 per cent from 1963 to 1972.

## SECOND-PARTY POSTING

Posting of road frontage by sportsmen's clubs or snowmobiling groups was negligible (less than 10 per cent of total posted frontage) for all areas of the State except Region 3. In this region, three of the four towns studied (i.e., all but the Town of Neversink) were heavily posted by second parties. Over two-thirds of the posted parcels in the Town of Minisink (Orange County) and about one-third of those in the Town of East Fishkill (Dutchess County) were posted by rod and gun clubs. About one-third of the Town of Patterson (Putnam County) was also posted, but much of this was part of the Putnam Cooperator Area which was posted by the Department in return for owners keeping other lands open for hunting and fishing.

## MESSAGES ON POSTING SIGNS

Over 94 per cent of the signs encountered in the study included the words "Posted" or "No Trespassing", both of which mean excluding everyone from the property. On the other hand, only 26 parcels had signs with the phrase "Hunting [or fishing] by Permission Only", and over half of these were posted by public agencies.

It is likely that messages on posting signs are more a reflection of the types of signs readily available on the market than of the landowners' specific intent. "Posted" and "No Trespassing", and these messages in combination with "No Hunting, No Fishing, No Trapping", account for

a very high proportion of the sign types for sale in New York. "No Snowmobiling" signs, signs excluding only one of the hunting-fishing-trapping activities, and signs allowing a given activity by permission only are not generally available in local sporting goods and hardware stores. In the absence of full choice, the landowner may be forced to buy a sign more restrictive than may be consistent with his attitude.

#### PARCELS AND ACREAGE POSTED

Of the 1,119 landowners who provided complete data on total acreage (Table 3) and amount of acreage posted, 467 (42 per cent) had posted all or part of their properties (Table 4). This does not include seven Fish and Wildlife Management Act cooperators who had posted their properties but allowed regulated hunting. The 42 per cent who posted held title to 48 per cent of the land in the sample and posted 86 per cent of their total acreage. Thus, 42 per cent of the private acreage in the sample was posted.

The 1,119 landowners held title to a mean of 123 acres, or a total of 137,637 acres. The 467 posting landowners posted a mean of 122 acres,

TABLE 3. SIZE OF PROPERTIES OWNED BY RESPONDING LANDOWNERS, BY REGION

| Region | Number of landowners | Acreage |      |
|--------|----------------------|---------|------|
|        |                      | Total   | Mean |
| 3      | 168                  | 12,466  | 74   |
| 4      | 216                  | 23,933  | 111  |
| 5      | 169                  | 29,727  | 176  |
| 6      | 99                   | 17,394  | 176  |
| 7      | 146                  | 20,104  | 138  |
| 8      | 159                  | 18,603  | 117  |
| 9      | 162                  | 15,503  | 96   |
| Total  | 1,119                | 137,730 | 123  |

TABLE 4. MEAN SIZE OF PROPERTIES OWNED BY POSTING AND NONPOSTING LANDOWNERS, AND MEAN ACREAGE POSTED, BY REGION

| Region | Posting landowners |              |        | Nonposting landowners |                    |
|--------|--------------------|--------------|--------|-----------------------|--------------------|
|        | Number             | Mean acreage |        | Number                | Mean acreage owned |
|        |                    | Owned        | Posted |                       |                    |
| 3      | 103                | 92           | 82     | 65                    | 47                 |
| 4      | 105                | 131          | 118    | 111                   | 91                 |
| 5      | 45                 | 230          | 165    | 124                   | 156                |
| 6      | 26                 | 240          | 183    | 73                    | 153                |
| 7      | 46                 | 174          | 151    | 100                   | 121                |
| 8      | 81                 | 146          | 135    | 78                    | 87                 |
| 9      | 61                 | 111          | 100    | 101                   | 87                 |
| Total  | 467                | 142          | 122    | 652                   | 109                |

TABLE 5. PERCENTAGE OF LANDOWNERS POSTING AND OF LANDS OWNED BY THEM, AND PERCENTAGE OF SUCH LANDS POSTED AND OF ALL PRIVATE LANDS POSTED, BY REGION

| Region | Landowners posting | Lands owned by posting landowners | Proportion posted       |                   |
|--------|--------------------|-----------------------------------|-------------------------|-------------------|
|        |                    |                                   | Lands of posting owners | All private lands |
| 3      | 60                 | 76                                | 89                      | 68                |
| 4      | 49                 | 57                                | 90                      | 52                |
| 5      | 27                 | 35                                | 72                      | 25                |
| 6      | 26                 | 36                                | 76                      | 27                |
| 7      | 31                 | 40                                | 87                      | 34                |
| 8      | 51                 | 64                                | 92                      | 59                |
| 9      | 38                 | 44                                | 90                      | 39                |
| Mean   | 42                 | 48                                | 86                      | 42                |

or a total of 56,974 acres. These totals for the sample data can be extrapolated to represent the 28-town study area by multiplying them by four (owing to the 25 per cent sample) and then by the factor 1761/1119 to account for the nonrespondents and undeliverable questionnaires. The resultant values can, in turn, be expanded by the factor 764/28 to represent the entire study area of 764 towns having a population density of less than 150 per square mile. Calculated in this way, 9.8 million acres were posted in the fall of 1972, out of 23.6 million acres of private lands in the study area. The entire study area represents 87.5 per cent of the acreage of upstate New York.<sup>5</sup>

The greatest incidence of posting was found in heavily populated Region 3 (southeastern New York) where 60 per cent of the landowners had posted 68 per cent of the private lands (Table 5). Region 8, which includes the four-county Rochester SMSA and borders the Buffalo SMSA, was the second most heavily posted, with 51 per cent of the landowners posting 59 per cent of the private lands. Region 4, which contains much of the Albany SMSA and extends sufficiently far south to draw considerable pressure from the New York City SMSA, also had over half its private lands posted.

Moderate amounts of posting were reported in Regions 7 and 9, where 34 and 39 per cent of private acreage was posted, respectively. The presence of Syracuse and Binghamton in Region 7, and of Buffalo in Region 9, appears counterbalanced by Southern Tier counties in each region where population densities and land use pressures are relatively low.

The least amount of posting was reported in Regions 5 and 6 in northern New York. These are the least heavily populated regions of the State and have the largest mean acreage per landowner. In addition,

<sup>5</sup>The New York City and Long Island areas were not surveyed.

the presence of vast public recreation areas in the Adirondacks undoubtedly relieves much of the demand that would otherwise be placed upon private landowners. That landowners in northern New York post a somewhat smaller proportion of their properties than landowners in other areas of the State may reflect this lesser recreational demand on their properties.

#### POSTING TRENDS

The 1963 study indicated that 25 per cent of private acreage was posted. The corresponding figure of 42 per cent in 1972 represents an increase of 68 per cent over the 9-year period. In total, the posting of private lands in the study area increased by approximately 4 million acres during the interval, from an estimated 5.9 million acres in 1963 to 9.8 million acres in 1972.

To gain insight into posting expectations for the immediate future, posting landowners were asked if they planned to continue posting during the fall and winter of 1972-73, while nonposting landowners were asked if they planned to post during the upcoming period. While 30 posting landowners planned to remove 4,002 acres from posted status, 61 landowners planned to begin posting on 7,143 acres. These data indicate that posting is still increasing and that approximately 540,000 additional acres were probably posted in rural New York during the winter of 1972-73. While there are no actual records for the annual increase in acreage posted between 1963 and 1972, the some 540,000 acres planned to be newly posted in 1972-73 was higher than the mean (approximately 444,000 acres) for the calculated difference in total posting between 1963 and 1972. Should posting continue at the current rate, all private lands in the State would be posted before the end of this century.

Landowners in the sample planned to post more acres than they

TABLE 6. CHANGES PLANNED IN POSTING BY RESPONDING LANDOWNERS FOR FALL AND WINTER OF 1972-73, BY REGION

| Region | Planned to newly post |       | Planned to remove from posting |       | Net change (acres) |
|--------|-----------------------|-------|--------------------------------|-------|--------------------|
|        | Number                | Acres | Number                         | Acres |                    |
| 3      | 8                     | 463   | 2                              | 78    | + 385              |
| 4      | 14                    | 2,293 | 6                              | 780   | +1,513             |
| 5      | 9                     | 1,515 | 1                              | 265   | +1,250             |
| 6      | 6                     | 481   | 1                              | 107   | + 374              |
| 7      | 9                     | 977   | 8                              | 1,925 | - 948              |
| 8      | 8                     | 833   | 7                              | 577   | + 256              |
| 9      | 7                     | 581   | 5                              | 270   | + 311              |
| Total  | 61                    | 7,143 | 30                             | 4,002 | +3,141             |

planned to remove from posting in all regions except Region 7 (Table 6). In this central New York region, eight of the 146 landowners sampled, owning a mean of over 200 acres, planned to remove their lands from posting.

### IDENTITY OF POSTING PARTIES

Statewide, 82 per cent of the posted parcels were posted by the landowner or his tenant, while the remaining 18 per cent were posted by a second party. Two-thirds of second-party posting was done by sportsmen's clubs, and the remainder represented posting under the Fish and Wildlife Management Act and miscellaneous types. Only one parcel, in Region 8, was reported to be posted by a snowmobiling club. This concurs with the findings of Hill (1971) that snowmobile clubs have thus far concentrated on obtaining permission to use private lands and on trail construction, rather than on posting such lands. The distribution of primary and second-party posting in the different regions is summarized in Table 7.

TABLE 7. PERCENTAGE OF PRIMARY AND SECOND-PARTY POSTING, BY REGION

| Region | Primary posting |        | Second-party posting |       | Total |
|--------|-----------------|--------|----------------------|-------|-------|
|        | Owner           | Tenant | Sportsmen's club     | Other |       |
| 3      | 72              | 2      | 20                   | 6     | 100   |
| 4      | 86              | 1      | 9                    | 4     | 100   |
| 5      | 81              | 2      | 12                   | 5     | 100   |
| 6      | 68              | 0      | 28                   | 4     | 100   |
| 7      | 81              | 4      | 6                    | 9     | 100   |
| 8      | 73              | 5      | 13                   | 9     | 100   |
| 9      | 84              | 5      | 3                    | 8     | 100   |
| Mean   | 79              | 3      | 12                   | 6     | 100   |

### POSTING BY ABSENTEE OWNERS

Absentee ownership (i.e., by persons living outside the county in which their rural property was located) was much higher in eastern New York (Regions 3, 4 and 5) than in the central and western parts of the State (Table 8). Although absentee landowners as a whole did not post at a significantly higher rate than local landowners (chi square difference of proportions test,  $p=0.95$ ), metropolitan absentees posted at significantly higher rates, and non-metropolitan absentees at significantly lower rates, than local landowners (Table 9).

The effect of absentee posting was most pronounced in Region 4, where 66 per cent of metropolitan absentees and 58 per cent of all absentees posted. Nevertheless, the net effect of absentee posting in this

TABLE 8. DISTRIBUTION (IN PER CENT) OF LANDOWNERS SAMPLED ACCORDING TO RELATIONSHIP OF THEIR RESIDENCE TO LOCATION OF THEIR PROPERTY, BY REGION

| Region | Owners resident in same county as property | Absentee owners  |              |       |
|--------|--------------------------------------------|------------------|--------------|-------|
|        |                                            | Non-metropolitan | Metropolitan | Total |
| 3      | 52                                         | 18               | 31           | 49    |
| 4      | 61                                         | 12               | 27           | 39    |
| 5      | 61                                         | 18               | 20           | 38    |
| 6      | 78                                         | 15               | 7            | 22    |
| 7      | 83                                         | 7                | 9            | 16    |
| 8      | 87                                         | 4                | 9            | 13    |
| 9      | 89                                         | 7                | 4            | 11    |
| Mean   | 69                                         | 9                | 20           | 29    |

TABLE 9. PERCENTAGE OF LOCAL AND ABSENTEE LANDOWNERS WHO POSTED, BY REGION

| Region | Owners resident in same county as property | Absentee owners  |              |       |
|--------|--------------------------------------------|------------------|--------------|-------|
|        |                                            | Non-metropolitan | Metropolitan | Total |
| 3      | 65                                         | 61               | 53           | 56    |
| 4      | 42                                         | 48               | 66           | 58    |
| 5      | 24                                         | 23               | 32           | 28    |
| 6      | 29                                         | 7                | 29           | 14    |
| 7      | 33                                         | 9                | 36           | 24    |
| 8      | 52                                         | 17               | 43           | 35    |
| 9      | 39                                         | 25               | 50           | 33    |
| Mean   | 41                                         | 33               | 50           | 43    |

region was to raise the local posting level by only 7 per cent. In the areas most heavily posted (i.e., Regions 3 and 8 as shown in Table 5) the degree of posting by metropolitan absentees was significantly lower than that by local residents.

Posting rates were also examined with respect to landowners not classified as absentees, but who lived in an area of urban influence (SMSA) even though it was in the same county as the survey property. In Region 6, while 29 per cent of both metropolitan absentees and local residents posted, 47 per cent of the local landowners in Oneida and Herkimer Counties who resided in the Utica-Rome SMSA posted. However, landowners living in the Syracuse, Rochester and Buffalo SMSA's who owned rural land in their county of residence posted at rates not significantly different from those of other landowners in their respective regions.

#### REASONS FOR POSTING

Judging that sufficient attention had been devoted by Waldbauer

(1966) and others to specific acts of trespassers, this study attempted to categorize the acts that led landowners to post and to identify the types of recreationists involved. Of the posting landowners, 55 per cent indicated that they had directly encountered bad experiences with recreationists. Of these, in turn, 56 per cent cited hunters; 26 per cent, snowmobilers; 7 per cent, fishermen; and 11 per cent, others not necessarily recreationists. Furthermore, 20 per cent of the landowners indicated that a friend or neighbor had encountered a bad experience—62 per cent with hunters, 24 per cent with snowmobilers, 6 per cent with fishermen and 11 per cent with others. Half of the posting landowners indicated they felt endangered by the presence of recreationists on their lands. Specifically, 72 per cent cited hunters; 21 per cent, snowmobilers; 4 per cent, fishermen; and 7 per cent, others.

The last reason frequently cited for posting was the reputation of recreationists for damaging property. The gap between the influence of hunters and that of snowmobilers on posting closed markedly with respect to reputation. Of the 37 per cent of landowners indicating reputation as a reason for posting, 44 per cent cited hunters and 39 per cent cited snowmobilers; another 7 per cent cited fishermen, while 10 per cent cited miscellaneous groups.

Over 97 per cent of posting landowners cited at least one reason that implicated the behavior of recreationists they had come in contact with or had heard about. Remaining landowners listed such reasons as desire for privacy, incompatible land use, and liability concerns (not realizing that a landowner in New York can no longer be found liable for injuries or damages suffered by major types of recreationists, excluding swimmers, who use his property free of charge).

No statistically significant regional differences were found regarding the types of recreationists responsible for posting or the reasons for posting.

Nine per cent of the nonposting landowners indicated their intent to post later in the fall or winter of 1972-73. Of these, 51 per cent cited hunters, 21 per cent cited snowmobilers, 13 per cent cited littering and vandalism by unknown parties and 15 per cent cited miscellaneous reasons as contributing to their intent to post.

These data indicate that fishermen make a comparatively small contribution toward the over-all posting problem. This is still the case when one examines only those properties containing a lake, stream or pond that affords fishing. Of the rural properties studied, 43 per cent contained such fishing waters, and 48 per cent of these were posted. Nevertheless, only 12 per cent of these landowners cited fishermen as having led them to post; 52 per cent cited hunters, 27 per cent cited snowmobilers and 9 per cent cited others.

## COMPARISON OF POSTING AND NONPOSTING LANDOWNERS

Perhaps the major difference between posting and nonposting landowners was brought out under the previous topic, i.e., posting landowners have often had bad experiences with recreationists (particularly hunters and snowmobilers), while nonposting landowners have less frequently encountered such experiences. Although the vast majority of all landowners had encountered a bad experience with recreationists at some time, only 11 per cent of all landowners, and 15 per cent of those who themselves hunt, could say they had never had a bad experience with hunters.

Differences between posting and nonposting landowners regarding both the characteristics of their property and their own attitudinal, socio-economic, demographic and recreational preference characteristics were analyzed in the hope of better explaining the increased posting phenomenon of the past decade.

**PROPERTY CHARACTERISTICS** In addition to the finding that posting landowners held larger acreages than nonposting landowners (Table 4), the only other difference in property characteristics of the two groups was that forest plantation owners are more likely to post than nonplantation owners. Statewide, 52 per cent of plantation owners posted. Whereas 41 per cent of posting landowners had forest plantations, averaging 14 acres, only 26 per cent of nonposting landowners owned plantations, and these averaged only 2 acres. Concern for the trampling of seedlings by both snowmobilers and hunters is apparently the cause of the more frequent posting by plantation owners.

The proportion of acreage in cropland, open fields, brush, natural woods, wetlands and miscellaneous categories did not differ significantly between posting and nonposting landowners. Nor was ownership tenure a differentiating factor; both posting and nonposting landowners had held title to their properties for an average of 18 years.

**ATTITUDES TOWARD HUNTING AND SNOWMOBILING** While the entire landowner sample endorsed hunting as a recreation activity much more strongly than snowmobiling, posting and nonposting landowners did not differ substantially in their views about the two activities (Table 10).

TABLE 10. DISTRIBUTION (IN PER CENT) OF POSTING AND NONPOSTING LANDOWNERS ACCORDING TO THEIR ATTITUDES ABOUT HUNTING AND SNOWMOBILING

| Attitude          | Posting landowners |              | Nonposting landowners |              |
|-------------------|--------------------|--------------|-----------------------|--------------|
|                   | Hunting            | Snowmobiling | Hunting               | Snowmobiling |
| Approve           | 76                 | 25           | 79                    | 35           |
| Have reservations | 22                 | 58           | 19                    | 52           |
| Disapprove        | 2                  | 17           | 2                     | 12           |

TABLE 11. DISTRIBUTION (IN PER CENT) OF POSTING AND NONPOSTING LANDOWNERS ACCORDING TO THEIR OPINIONS CONCERNING THE BEHAVIOR OF HUNTERS AND SNOWMOBILERS

| Opinion       | Posting landowners |              | Nonposting landowners |              |
|---------------|--------------------|--------------|-----------------------|--------------|
|               | Hunters            | Snowmobilers | Hunters               | Snowmobilers |
| Responsible   | 29                 | 35           | 74                    | 56           |
| Irresponsible | 71                 | 65           | 26                    | 44           |

Posting and nonposting landowners varied markedly, however, in their attitudes about the behavior of these recreationists. While 74 per cent of the nonposting landowners felt hunters to be generally responsible, only 29 per cent of the posting landowners concurred (Table 11). Similarly, 56 per cent of nonposting landowners felt snowmobilers were usually responsible, but only 35 per cent of posting landowners held this view. These data seem to support the hypothesis that the propensity to post is more a function of landowner experiences with recreationists than of the landowners' backgrounds and socio-economic characteristics.

**PARTICIPATION IN RECREATIONAL ACTIVITIES** Of 12 recreational activities selected for examination (Table 12), posting and nonposting landowners differed significantly (chi square difference of proportions test,  $p=0.95$ ) in their participation rates for only three: deer hunting, hiking and nature study. While the difference for deer hunting (49 per cent for posting versus 45 per cent for nonposting landowners) is statistically significant, it would account for a very small proportion of the posting variance of the two groups (44 per cent of deer hunters and 40 per cent of non-deer hunters posted) and likely is not very meaningful in terms of management implications.

TABLE 12. PERCENTAGE OF HOUSEHOLDS OF POSTING AND NONPOSTING LANDOWNERS WITH ADULT PARTICIPATION IN OUTDOOR RECREATIONAL ACTIVITIES IN 1971-1972.

| Activity             | Posting landowners | Nonposting landowners |
|----------------------|--------------------|-----------------------|
| Deer hunting         | 49                 | 45*                   |
| Small game hunting   | 47                 | 44                    |
| Pheasant hunting     | 24                 | 23                    |
| Duck hunting         | 12                 | 11                    |
| Trapping             | 7                  | 8                     |
| Fishing              | 46                 | 44                    |
| Hiking               | 40                 | 32*                   |
| Nature study         | 39                 | 25*                   |
| Recreational cycling | 10                 | 10                    |
| Snowmobiling         | 31                 | 35                    |
| Snowshoeing          | 11                 | 12                    |
| Cross-country skiing | 6                  | 3                     |

\* Difference significant at 95 per cent level of confidence.

Hiking and nature study participants had somewhat stronger attitudes against hunting and snowmobiling than the rest of the sample. This is not particularly surprising, since many recreationists would not view the two sets of activities as complementary. The data showed that 48 per cent of hikers and 52 per cent of nature study participants posted their properties.

**SOCIO-ECONOMIC CHARACTERISTICS** Regardless of whether they now live on their rural properties, landowners who were reared in a metropolitan area posted significantly more frequently ( $p=0.95$ ) than other landowners. Since 57 per cent of all parcels held by this group fell within heavily posted Regions 3 and 4, these landowners would be expected to post at a higher rate than the statewide average. If they posted at the same rate as others in their respective regions, 47 per cent would post. In fact, 54 per cent of these 171 metropolitan-reared landowners posted their holdings. The greatest differences in the rates of posting by metropolitan-reared and non-metropolitan-reared landowners occurred in Re-

TABLE 13. PERCENTAGE OF LANDOWNERS WHO POSTED ACCORDING TO BACKGROUND, BY REGION

| Region | Background                  |                                 |
|--------|-----------------------------|---------------------------------|
|        | Reared in metropolitan area | Not reared in metropolitan area |
| 3      | 50                          | 65                              |
| 4      | 71                          | 38                              |
| 5      | 27                          | 27                              |
| 6      | 29                          | 26                              |
| 7      | 36                          | 31                              |
| 8      | 73                          | 49                              |
| 9      | 59                          | 34                              |
| Mean   | 54                          | 40                              |

gions 4, 8 and 9 (Table 13). In Region 3, however, metropolitan-reared landowners posted less frequently than others.

Since it has been widely assumed that both metropolitan absentee owners and those reared in metropolitan areas post more frequently statewide than do other landowners, posting behavior of the two groups was examined concurrently. In Regions 3 and 4 there was an approximately 50 per cent overlap in these demographic groupings, and there was a 31 per cent overlap in Region 5. The degree of overlap was less than 25 per cent in other regions. In total, 30 per cent of the rural landowners sampled had the influence of metropolitan living via either their major childhood residence or their current residence. In all, 51 per cent of this metropolitan group posted, while 38 per cent of landowners having little or no metropolitan influence posted.

Among occupational groups, 49 per cent of professional, technical and managerial employees posted. This rate was significantly higher ( $p = 0.95$ ) than those for farmers (41 per cent), housewives, retired and clerical-sales landowners (39 per cent) and blue-collar landowners (37 per cent). There was no difference in posting rates for male and female landowners.

Landowners with higher incomes posted more frequently than those with middle or lower incomes. Of landowners having gross incomes of \$15,000 or more, 50 per cent posted, compared with only 33 per cent for those with gross incomes of less than \$6,000. Of those in the \$6,000 to \$10,000 income range, 43 per cent posted, compared with 38 per cent for those having total family incomes in the \$10,000 to \$15,000 range.

Since the proportion of landowners with incomes of less than \$6,000 who posted (33 per cent) represented the lowest proportion of any socioeconomic or demographic group among those who posted, and the proportion of landowners with incomes of at least \$15,000 (50 per cent) was among the highest, detailed analyses of these two groups were made

TABLE 14. COMPARISON OF RURAL LANDOWNERS HAVING DIFFERENT INCOME LEVELS ACCORDING TO VARIOUS OTHER FACTORS

| Factor                            | Income level      |                  |
|-----------------------------------|-------------------|------------------|
|                                   | Less than \$6,000 | \$15,000 or more |
| Property                          |                   |                  |
| Acres owned (mean)                | 110               | 143              |
| Years owned property (mean)       | 25                | 14               |
| Posted (per cent)                 | 33                | 50               |
| Location of property              |                   |                  |
| Regions 3 and 4 (per cent)        | 22                | 46               |
| Regions 5 and 6 (per cent)        | 28                | 25               |
| Regions 7, 8 and 9 (per cent)     | 50                | 29               |
| Landowner characteristics         |                   |                  |
| Metropolitan residence (per cent) | 19                | 33               |
| Age (mean years)                  | 62                | 50               |
| Education (mean years)            | 10                | 14               |
| Sample size                       |                   |                  |
| Number                            | 166               | 290              |
| Percentage of total sample*       | 19                | 33               |

\* Including those having incomes between \$6,000 and \$15,000.

(Table 14). Middle income landowners posted at near the statewide rate of 42 per cent and are not included in Table 14.

While differences between all posting and nonposting landowners are not as striking as those between upper and lower income landowners, Table 14 helps in formulating a useful composite of groups having the highest and lowest tendencies to post. Older, often retired landowners in central and western New York who have rural backgrounds and live near their rural properties have the lowest tendency to post. Conversely, land-

owners having rural properties closest to New York City, who have higher mobility and incomes and who have developed more urban value orientations have the highest tendency to post.

#### REASONS FOR NOT POSTING

In addition to analyzing and comparing the characteristics of posting and nonposting landowners, the nonposting landowners were asked why they didn't post. In their responses: 47 per cent indicated that the people who used their lands in the past had been cooperative and careful not to damage the property; 46 per cent indicated they appreciated the privilege of using other private lands for recreation and, therefore, felt they should leave their lands open; 20 per cent said they were aware of State efforts to keep lands open and were trying to cooperate; 15 per cent reported there was nothing on their property anyone could damage; and 15 per cent reported no one had ever used their property for recreation.

Nevertheless, not all nonposting landowners are pleased with landowner-recreationist relationships. Seven per cent indicated an intention to post which simply had been neglected to date. Another 7 per cent indicated that posting didn't help—the signs were ignored and the laws were not enforced.

Approximately 20 per cent of nonposting landowners had posted at some time in recent years. Of these: 26 per cent reportedly stopped posting because their signs were either ignored or destroyed; 25 per cent stopped because of less pressure from hunters; 17 per cent indicated they had just neglected to post this year (1972); 13 per cent reported their property had reverted to nonactive uses; and 17 per cent reported miscellaneous reasons. Only 5 per cent indicated they had stopped posting due to changes in the State's liability laws.

#### ATTITUDES ABOUT GUNS AND GAME

Prompted by three notorious political assassinations and numerous hijackings in the recent past, many writers and social scientists have questioned the future role of guns of all types in American society. While hunting is obviously still widely approved of in rural America, attitudes toward the use of pistols for sporting purposes might logically be stronger than attitudes toward hunting with long-barrelled weapons. If there is changing opinion toward possession of firearms, it would probably be first reflected in attitudes regarding the restriction of pistols. Because it was felt that data on this topic are important for analyzing current opinion and also as baseline data for future comparative studies, a question on such attitudes was designed for rural landowners in this study.

Of the rural landowners canvassed, 21 per cent indicated their belief that "every American should have the right to have in his possession, and

legally use, sporting firearms, including pistols" without reservations. At the same time, 35 per cent indicated that, while they agreed with the foregoing statement, pistols should be registered for public protection. Another 33 per cent were yet more restrictive, believing that pistol permits should be given only to persons passing a strong character examination. Finally, 12 per cent felt that major crimes are now so serious that possession of pistols should be restricted to use by law enforcement officials.

As might be anticipated, attitudes about possession of pistols were more stringent in heavily populated Region 3 than in central and western New York. While 36 per cent of the respondents in Region 3 favored a strong character examination and another 16 per cent favored restriction of pistol possession to law enforcement officials, in Region 9 only 27 per cent of the landowners favored a character examination and only 9 per cent favored barring pistol possession.

An important wildlife management principle in America centers around the concept of public ownership of game. While the landowners surveyed were concerned about recreational abuse of private lands, they generally favored current policies. State wide, 75 per cent preferred the private-public management mix in which the State establishes and enforces regulations to protect the game supply and the private landowner has control over who hunts on his property. Only 7 per cent felt that the private landowner should totally manage the game on his property regardless of seasons or bag limits. On the other hand, 17 per cent felt hunters should have the right to hunt on open, unposted lands without obtaining permission, so long as they do not damage private property. Only 1 per cent felt hunters should be allowed to hunt on idle lands without obtaining permission, so long as they obey game regulations.

The only statistically significant regional differences occurred in northern New York, where 30 per cent of the landowners felt hunters need not request permission to use unfenced lands. The larger land parcels and higher proportion of open lands in this part of the State undoubtedly account for this deviation from statewide attitudes.

#### RECREATIONAL DEMAND FOR PRIVATE LANDS AND LANDOWNER RESPONSE

Recreational demand for private lands is difficult to approximate from a landowner survey for numerous reasons. Foremost, posting landowners don't know how many recreationists would like to use their properties, and many landowners don't know how often their lands are being used without permission. Nevertheless, it is important to gain an understanding of landowners' perceptions of this demand for use of their lands, for it may provide insight into how likely these landowners are to impose more stringent controls in the near future.

The primary group to examine in such an analysis is landowners who

allow strangers to use their lands, either with or without first obtaining permission. This supposition is made because hunters who travel to areas they believe to be good hunting habitat without having advance local contacts are the ones who have the greatest difficulty in finding private lands on which to hunt. The same applies to snowmobiling, fishing and related activities. In addition, strangers are less likely than friends or neighbors to respect the landowner's property. It is perhaps this group of landowners that are most likely to post in the future.

**HUNTING** Of the responding landowners, 43 per cent indicated that they allowed strangers to hunt on their property. Of these: 8 per cent indicated their property was not used at all for hunting; 38 per cent indicated their property received light use; 36 per cent indicated moderate use; and 18 per cent characterized the amount of hunting as heavy (Table 15). This perception of use intensity was relatively consistent for all re-

TABLE 15. DISTRIBUTION (IN PER CENT) OF DEGREE OF HUNTING ACTIVITY ON THEIR PROPERTY DURING PREVIOUS YEAR AS REPORTED BY 487 LANDOWNERS WHO ALLOWED STRANGERS TO HUNT, BY REGION

| Region | Degree of hunting activity |       |          |       |
|--------|----------------------------|-------|----------|-------|
|        | None                       | Light | Moderate | Heavy |
| 3      | 12                         | 41    | 38       | 10    |
| 4      | 9                          | 32    | 41       | 18    |
| 5      | 5                          | 49    | 30       | 16    |
| 6      | 14                         | 43    | 35       | 8     |
| 7      | 7                          | 35    | 41       | 17    |
| 8      | 7                          | 34    | 31       | 28    |
| 9      | 4                          | 38    | 38       | 20    |
| Mean   | 8                          | 38    | 36       | 18    |

gions. At least 40 per cent of the landowners in each region who allowed strangers to hunt indicated that their property received light, if any, hunting use. On the other hand, only in Region 8 was heavy hunting use indicated by over 20 per cent of the landowners.

Statewide, landowners permitting strangers to hunt reported that they were asked an average of six times (standard deviation: 12.0) for hunting privileges in the 12 months preceding the study. An average of 5.5 (92 per cent) of such hunting requests were allowed. These landowners were also aware of a mean of 7.8 occasions when their property was used for hunting without permission. Since 83 per cent of this group wished to allow hunting by strangers with permission only, the amount of hunting without permission is alarmingly high.

**FISHING** Of the 486 responding landowners whose properties contained or bordered a lake, pond or stream that afforded fishing, 51 per cent allowed strangers to fish. Of these, 34 per cent indicated that they

had received no requests to fish within the previous 12 months, and an additional 37 per cent indicated light use of their property for fishing. At the same time, 21 per cent indicated moderate use and 8 per cent indicated heavy use.

The small sample size for landowners having properties containing or bordering fishable waters and allowing strangers to fish makes regional comparisons of use difficult. Nevertheless, over 60 per cent of these landowners in each region reported no use, or light use, of their properties for fishing. Statewide, these landowners were asked for fishing permission an average of only 2.7 times in the previous 12 months (standard deviation: 8.4). The average approval rate of 2.5, with a standard deviation of 8.2, suggests that very few requests were turned down.

As with hunting, landowners who allowed fishing indicated that more people fished without asking permission (mean of 3.4 in the previous year, with a standard deviation of 10.5) than requested permission. This would seemingly try the patience of even these cooperative landowners, since 78 per cent indicated that they expected fishermen to request permission.

**SNOWMOBILING** Only 32 per cent of responding landowners indicated that they allowed strangers to snowmobile on their property. Statewide: only 8 per cent of these landowners reported no snowmobiling use of their property; 27 per cent indicated light use; 34 per cent indicated moderate use; and 31 per cent felt their property received heavy snowmobiling use. Regionally, two-thirds to three-fourths of those in Regions 5, 6, 7 and 8 indicated moderate to heavy snowmobiling use of their properties, compared with 56 per cent in Region 4 and 59 per cent in Region 9. While the number of landowners in the sample who permitted snowmobiling by strangers ranged from 50 to 58 in Regions 4 to 9, only 19 were found in Region 3. Thus, the primary demand-related problem in the latter region is that only 11 per cent of its rural landowners permit snowmobiling.

Statewide, landowners who allowed snowmobiling were asked for snowmobiling privileges a mean of 5.2 times (standard deviation: 14.5). Virtually all requests were granted. These landowners further noted that they were aware of a mean of 8.5 (standard deviation: 18.6) occasions in the previous year when their property had been used for snowmobiling without their permission. However, 75 per cent indicated they wanted snowmobilers to request permission before using their lands.

## DISCUSSION

The results of the present survey show that there has been a substantial increase in posting in New York State during the past decade. They also provide information on the attitudes of landowners with respect to the

use of their lands by recreationists and the need for posting. From these data, the principal causes of the posting problem may be assessed and possible solutions suggested.

#### DIFFERENCES BETWEEN 1963 AND 1972 STUDIES

The primary thrust of the 1963 study was the work carried out by the field survey. That study gave major attention not only to road frontage posted, but also to the legality of the posting signs and to rural land use associated with posting. It was carried out in 100 towns, compared with only 28 chosen for the 1972 study. While the 1963 study obtained data on reasons for posting and posting behavior, it obtained relatively little socio-economic and attitudinal information based on a sample size of only 361 ( 5 per cent).

The 1972 study, on the other hand, focused on landowner attitudes and posting vs. nonposting behavior reported by mail questionnaire based on a sample size of 1,761. It employed a sampling design from which both statewide and regional information could be derived. It incorporated the land-use information obtained in 1963 via field survey. In fact, the major reason for retaining the field survey in 1972 was to have at least one parameter of direct comparison (road frontage posted) with the 1963 survey.

In retrospect, the field survey has potentially important supplemental value to a posting study, but it is of limited over-all value. Field surveys of road frontage posted may simulate perspectives of available recreational access to strangers traversing the same towns in search of access, but this is not an accurate assessment of property open to recreationists. On the one hand, many landowners post to regulate activities on their property, but they allow some hunting and other activities, even by strangers. On the other hand, a sizeable group of landowners allow no hunting or other activities, or they allow participation by friends and neighbors only, yet they have not posted for various reasons. These reasons and related attitudes can only be obtained by contacting landowners, and mail questionnaires have recently proven to be reliable and a comparatively inexpensive means of obtaining such information.

#### INTERPRETING FIELD SURVEY VERSUS QUESTIONNAIRE DATA

It has been pointed out that a bias existed with respect to the reported increase in road frontage posted from 16 per cent in 1963 to 29 per cent in 1972 because of not examining the conversion of huntable road frontage to residential and commercial development. Fortunately, this bias was notable in only four of the 28 towns studied and had the effect of making the recorded increase conservative.

If this bias is not prominent statewide, readers may well question why

the percentage of road frontage posted (29 per cent in 1972) is less than the proportion of private acreage posted (42 per cent) during the same year. One would expect posting landowners to post road frontage initially and to post off-road parcels only if trespass problems persisted. The answer to this paradox is that the field surveys were made in spring and summer for both the 1963 and 1972 surveys. Many landowners who post during the hunting season (and perhaps against snowmobiling in winter) take their signs down in the off-season to protect them. The Department and project personnel were well aware of this problem at the time of both studies, but the law enforcement duties of conservation officers during fall and winter prohibited their working on the field survey at this time of year.

For these reasons, the 42 per cent of the State's rural landowners (of parcels of at least 10 acres), derived from the mail questionnaire as posting 42 per cent of private rural acreage, is the more accurate estimate of posting incidence. Although the degrees of road-frontage posting reported for both 1963 and 1972 (16 and 29 per cent, respectively) are obviously low, the authors believe that the 81 per cent increase over the 9-year period, obtained via identical techniques during the same season, is indicative of the increase in such posting during that time.

#### INTERPRETATION OF THE "POSTING PROBLEM"

In an attempt to further "explain" the causes or factors associated with current posting rates, a stepwise multiple regression analysis was employed. The 28 towns surveyed were the case units, and the percentage of landowners posting was the dependent variable. Independent variables, obtained both from study results and secondary sources, included population density, age, education, income, distance to the nearest SMSA center, property value per capita, population mobility, average acreage, percentage of absentee landowners and percentage of landowners residing in an SMSA.

The best model obtained, i.e., that in which individual  $F$ -values are each significant at  $p=0.90$ , the over-all  $F$ -value is significant at  $p=0.95$ ,  $r$ -square is maximized and the standard error of the estimate is minimized, is given by the equation

$$Pp = 12.0Me + 9.26Ed + 0.10Pv - 70.48$$

where

$Pp$  = percentage of landowners posting by town

$Ed$  = median years of education for adults over 25 years of age

$Me$  = percentage of landowners currently residing in an SMSA

$Pv$  = property value per capita in 1965 (in thousands of dollars)

This model has an  $r$ -square of 0.62 and a standard error of 11.60 per cent (absolute) in estimating the percentage of landowners posting by town. The  $r$ -square of variable  $Me$  alone is 0.29. Variable  $Ed$  increases the  $r$ -square to 0.52, and the addition of  $Pv$  increases it to 0.62. Of the independent variables on which data were available, SMSA residence was the most important in explaining the amount of posting in each town. This variable, as well as education level and property value per capita, were positively correlated with posting.

While metropolitan-linked landowners unquestionably post more frequently than other landowners, their contribution to the statewide posting problem should be kept in proper perspective. Approximately 42 per cent of all rural landowners posted their lands in 1972. Without the contribution of the metropolitan-linked landowners, a moderately high amount of posting (38 per cent) would still exist. While it is reasonable to assume that the rate of posting will increase if major growth in the State's metropolitan population continues and if these people continue to purchase rural lands, there is no strong evidence that the statewide posting level would exceed this group's current 52 per cent rate of posting as a result of this factor alone. The metropolitan influence, in combination with other factors, however, has the potential to push the statewide posting rate well above 52 per cent within a few years.

Although a variety of socio-economic and demographic variables were available as independent variable inputs into the regression model, only 62 per cent of the variance in the posting rates of the 28 sample towns was explained. The authors believe that the remaining variance is largely explained by the frequency with which landowners in various localities encountered bad experiences with recreationists. Quantitative measures of these bad experiences were not obtained in the survey.

Although the demand for recreational use of private lands has become a year-around one, most landowners do not object to the density or frequency of recreationists. Few complain that their privacy is infringed upon or that they have little time for their own recreational use of these lands. In fact, this study seems to indicate that most landowners who allow the use of their land believe that recreational use of private lands across the State is not great.

The major problem, and a serious one, is the behavior of recreationists who use these lands. It appears that most recreationists (especially strangers) do not bother to request permission. This in itself is a serious offense to many landowners. In addition, hunters and snowmobilers have developed reputations for being careless, sometimes vandalistic, individuals who show little respect for private property. Landowners who have experienced such occurrences usually subscribe to this stereotype, while those who have not experienced it (or have not had a friend or neigh-

bor experience it) usually do not. This study indicates that the number of those encountering bad experiences is rapidly increasing.

If this phenomenon of negative landowner-sportsman relationships continues, New York may see legislation similar to that proposed and sometimes passed in other states which in essence posts all lands, requiring recreationists to have either oral or written permission before entering private lands. While legislation in itself seldom solves behavioral problems, it seems clear that the majority of landowners in this study would support such legislation.

### POSSIBLE SOLUTIONS

While more stringent legislation or penalties might provide limited short-term relief from the problem, most experts assert that positive, rather than punitive, steps are required for long-term behavior modification. Such steps include the elements of education-communication, as well as rewards and reinforcements. In conflict situations, these must be applied to both parties involved—landowners as well as recreationists.

Landowners need to become more sympathetic to the recreational needs of urbanites and other small property owners, but, at the same time, they need to be recognized for the magnitude of their service in opening their lands to recreationists. They also need to be educated as to the role of hunting and fishing in stabilizing fish and game populations.

Recreationists, on the other hand, need to understand the seriousness of the consequences, in terms of the effect on the supply of private recreational resources, of continued negligence in improving their image and the need to establish rapport with landowners. Continued multimedia publicity and educational efforts, such as those the Department has recently employed via the fishing and hunting syllabus, radio and television spot messages and press releases, will be needed to reach these audiences.

Public agencies can contribute to the resolution of recreational access problems in several additional ways. They can aid and coordinate publicity efforts in cooperation with sportsmen's groups and industry. They can help sponsor forums in which communication between landowners and recreationists occurs. They can point out areas (public, private or cooperative) where specific types of recreation are available to the public. Finally, they can review their own planning and operational policies to see that the recreationist is getting his public dollar's worth of public facilities, thereby relieving the private sector of some of the recreational demand. It is well recognized that one reason for negligent behavior is frustration over a lack of facilities or services sought. This has been pointed out recently in regard to snowmobiling. Trail sys-

tems are needed in many areas of the State. Publicizing those currently existing, as well as providing other trails via public and private coordination, would likely result in fewer landowner complaints about snowmobiling.

A different tack bearing considerable potential influence on this problem was undertaken by the Agricultural Stabilization and Conservation Service on a pilot basis in five counties of New York, and in nine other states, during 1974. In each pilot county, a cash subsidy was offered to eligible farmers who applied for the program, for opening their lands to hunting or fishing or both. Such a program has both potential strengths and problems. On the one hand, it would open acreage that perhaps would have otherwise been closed to recreationists, thereby reducing the pressure placed upon other landowners. On the other hand, such a program would be tremendously expensive to administer state-wide or nationwide (the future of the Service's program is in considerable doubt for this reason). In addition, a widespread subsidy program might destroy the remaining vestiges of the concept that hunting and fishing should be freely provided by landowners. This study shows that only 9 per cent of the State's rural landowners currently feel they should open their lands to recreationists only if financially reimbursed. Landowners are currently far more interested in protection of themselves and their property than in financial remuneration.

It is apparent that the problem of posting and landowner-sportsman relationships is of major proportions and that its resolution will require major coordinated efforts. Concurrent with long-term programs geared to evaluate such efforts, continued research will be needed to make certain that the dimensions and scope of the problem continue to be correctly perceived.

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# OFFSHORE OIL AND FISHERY RESOURCES<sup>1</sup>

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## ABSTRACT

The prospect of petroleum reserves off New York and adjacent states has focused a detailed look at the living marine resources of the area as they might be affected by drilling for the petroleum and by possible oil spills. This paper reviews the offshore and coastal fishery resources in relation to the suspected petroleum reserves.

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Proposals by the Federal government and the oil and gas industry to seek possible petroleum reserves for exploitation off the East Coast of the United States have aroused widespread controversy. Resource agencies, citizen organizations and fishermen are concerned about what might happen if oil is found and extracted from lands within the Outer Continental Shelf. They suspect and fear damage to the fisheries which are an important source of recreation, food and income. The fisheries are productive and valuable and are harvested by anglers (Jensen, 1974a) as well as commercial fishermen.

This paper describes some of the living marine resources in that part of the Middle Atlantic Bight of interest to New York and discusses the volume and value of the harvested portions of the resources and their socio-economic impact. The information is presented as an aid to the decision makers who must evaluate the known fishery resources against the as-yet-unknown petroleum resources.

## THE OIL SURVEY AREA

The scope of the seismic surveys for oil-bearing sediments off the East Coast has been extensive. An early report (Anonymous, 1968) stated that "Interior Department's Geological Survey plans to permit the Continental Oil Company (CONOCO) to conduct a geophysical seismic survey of the Outer Continental Shelf—from Florida waters through the Georges Bank area." The survey area is in international waters, well beyond the 22-kilometer (12-mile) limit of the contiguous fishery zone established by the United States.

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The surveys provided evidence of several sites on the Outer Continental Shelf that might be sources of petroleum. Maher (1971) reported that "the Bahama platform, the seaward extension of the Cape Fear arch, the long basement ridge at the edge of the Continental Shelf off New England, and the Southeast Georgia embayment appear . . . to be the areas most favorable for initial operations in waters controlled by the United States". Two of the sites are of particular interest to New York and the adjacent coastal states (Figure 1). One is the Baltimore Canyon Trough which is parallel to the edge of the Continental Shelf for about 81 kilometers from about 40° N. to about 38° N. The other is the Georges Bank Trough which is adjacent to the southeastern edge of Georges Bank, one of the most productive fishing banks in the world. This trough is about 136 kilometers long and in some places about 46 to 55 kilometers wide.

The thickest sediments (i.e., where there is the greatest likelihood of oil and gas accumulations) of the Georges Bank Trough are farther from shore than any of the other petroleum provinces of the Outer Continental Shelf considered (Council on Environmental Quality, 1974). The probability of a spill at the easternmost site on Georges Bank reaching shore would be a maximum of 15 to 20 per cent in the spring and near zero in the winter, and the oil would take from 80 to 150 days to reach shore. The probability of a spill on the western part of the bank reaching shore would be 35 to 50 per cent in the spring and zero to 10 per cent in the winter, and the oil would take 40 to 120 days to reach shore.

The thickest sediments of the Baltimore Canyon Trough are 93 to 139 kilometers offshore. The probabilities of spills from this petroleum province reaching shore were summed up by the Council on Environmental Quality (1974) as follows:

"Although there is only a 10 per cent chance that oil spilled 50 miles [93 kilometers] south of Long Island . . . would come ashore on Long Island during the spring, this probability increases dramatically as the hypothetical oil release point moves north toward Long Island. Oil released 25 miles [46 kilometers] south of Long Island in the spring would come ashore 75 per cent of the time; oil released 10 miles [18 kilometers] south would come ashore 95 to 100 per cent of the time during that season. The probabilities are considerably lower in the winter."

In the Southern New England-Middle Atlantic waters, the surveyed area is within two statistical divisions recognized by the International Commission for the Northwest Atlantic Fisheries. One division, 5Zw (Subarea 5), extends from the vicinity of Montauk Point east to Nantucket Island and south for about 94 kilometers. The other division, 6A (in Statistical Area 6), extends offshore from Montauk Point to Cape May for about 54 kilometers. Division 5Zw is part of the Commission's convention area that is regulated by multi-lateral (15 nations) conservation agreements and regulations. Statistical Area 6 was established for

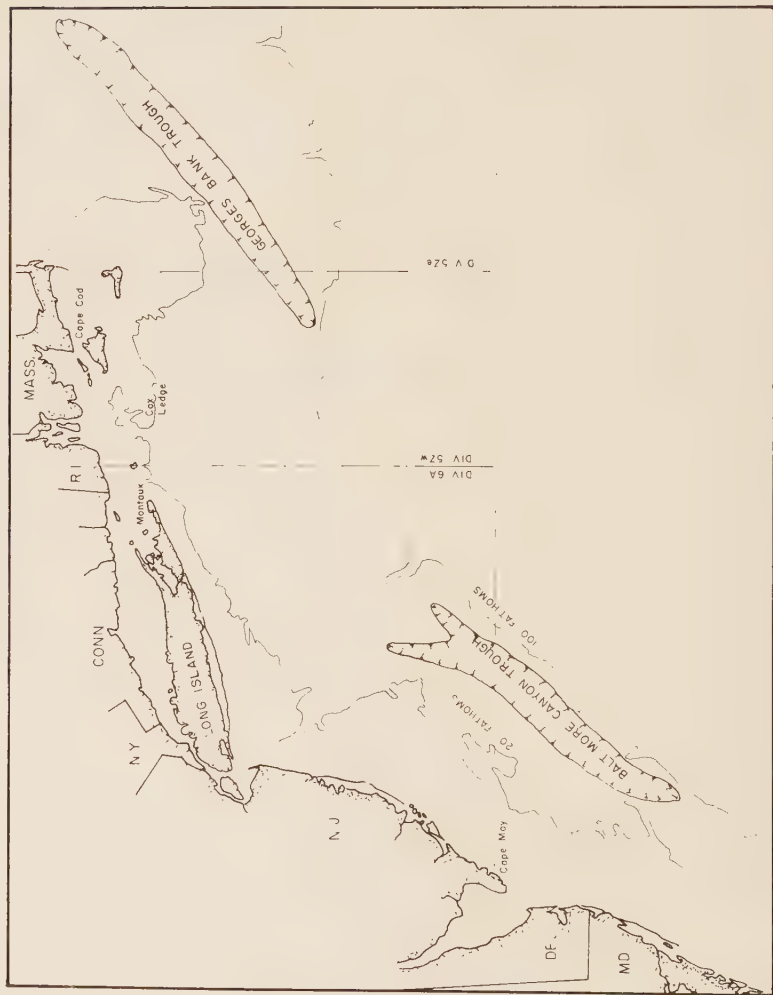


Figure 1. Part of the Middle Atlantic Bight and the prospective oil provinces.

the gathering of fisheries statistics only, but it is part of the area covered by bi-lateral fisheries agreements between the United States and the USSR and Poland.

### THE FISHERY RESOURCES

Commercially valuable shellfish that occur offshore in the surveyed area are the sea scallop (*Placopecten magellanicus*), surf clam (*Spisula solidissima*), ocean quohog (*Arctica islandica*) and American lobster (*Homarus americanus*). The latter three have been classified by the Federal government as creatures of the Continental Shelf and may be harvested only by U.S. vessels.

In addition to the offshore shellfish resources, there are valuable inshore shellfish resources such as the hard clam (*Mercenaria mercenaria*). The inshore areas could be affected by spills from any exploitation of the potential petroleum resources offshore. Furthermore, any oil on the inshore areas could be expected to affect the resources for a considerable period of time. It has been shown (Blumer et al., 1973) that spilled oil stranded in a coastal wetland on Cape Cod had "an unanticipated degree of persistence (including the high boiling components) even under conditions thought favorable to weathering". The pollutant in the Cape Cod study formed what the authors termed a "standing crop" of fossil fuel and a potential for ecological damage to the coastal ecosystem far greater than might have been anticipated. Thus, oil spills that become stranded on Long Island shores could persist for long periods of time and cause severe damage to hard clams and other non-motile forms.

About 15 species of pelagic and bottom fish are important in the surveyed area. Most of them traditionally have been harvested by U.S. fishermen. In recent years, however, large fleets of foreign vessels have entered these fisheries and, in most cases, dominate the catches (Jensen, 1971c). There are also extremely active recreational fisheries, both offshore and inshore, and in many instances anglers and commercial fishermen seek the same species. The recreational fisheries have been described by Briggs (1965, 1968), Schaefer (1968) and Jensen (1973, 1974a).

### PRODUCTION AND VALUE

Statistics for the several fisheries in the surveyed area are contained in a number of sources. Wheeland (1975) reported that in 1974 the surf clam fishery landed 43,587 metric tons, of which 1,792 metric tons came from beds off Long Island. In 1974, New York's landings of surf clams were worth \$719,060 at the dock (National Marine Fisheries Service, 1975). In 1974, the hard clam fishery in New York harvested 3,641 metric tons of meats worth \$13.4 million at the dock; local shellfish producers estimated the retail value at \$100 million. The total shellfish land-

TABLE 1. COMMERCIAL LANDINGS (IN THOUSAND METRIC TONS) OF MAJOR SPECIES FROM HIGH SEAS OFF NEW YORK, 1973\*

| Species                                                  | Area§  |       |        |       |
|----------------------------------------------------------|--------|-------|--------|-------|
|                                                          | 5Zw    |       | 6A     |       |
|                                                          | Total† | U.S.  | Total† | U.S.  |
| Atlantic herring ( <i>Clupea harengus</i> )              | 18.25  | 3.94  | 11.46  | 0.29  |
| Atlantic cod ( <i>Gadus morhua</i> )                     | 2.81   | 1.09  | 0.27   | 0.06  |
| Silver hake ( <i>Merluccius bilinearis</i> )             | 48.85  | 1.91  | 11.92  | 0.37  |
| Red hake ( <i>Urophycis chuss</i> )                      | 24.63  | 2.38  | 15.74  | 0.55  |
| Striped bass ( <i>Morone saxatilis</i> )                 | 0.11   | 0.11  | 0.00   | 0.00  |
| Scup ( <i>Stenotomus chrysops</i> )                      | 1.09   | 0.58  | 0.72   | 0.50  |
| Atlantic mackerel ( <i>Scomber scombrus</i> )            | 159.43 | 0.23  | 44.87  | <0.01 |
| Yellowtail flounder ( <i>Limanda furruginea</i> )        | 2.82   | 2.64  | 2.36   | 2.17  |
| Winter flounder ( <i>Pseudopleuronectes americanus</i> ) | 3.27   | 2.38  | 0.50   | 0.47  |
| American lobster ( <i>Homarus americanus</i> )           | 0.54   | 0.54  | <0.01  | <0.01 |
| Sea scallop ( <i>Placopecten magellanicus</i> )          | <0.01  | <0.01 | 1.19   | 1.19  |

\* From International Commission for the Northwest Atlantic Fisheries (1975).

§ Division as recognized by the above International Commission (see text).

† Includes landings reported by foreign vessels.

ings for New York in 1974 were 7,598 metric tons worth \$21 million, ex-vessel (price received by the fisherman).

The commercial catch of some species taken by domestic and foreign fishermen in the waters off New York (and likely to be affected by exploratory and production drilling for oil) is shown in Table 1. A breakdown of values for these catches is not available; however, New York's share was \$4 million, ex-vessel. The total annual value of the catches, both foreign and domestic, is estimated to have been about \$116 million. Gordon (1973) estimated that the waters off New England (Subarea 5) produce \$150 million worth of finfish each year, including both the domestic and foreign harvests.

Data for the recreational fisheries are less precise than those for the commercial fisheries. The corps of trained and experienced dockside interviewers who collected the commercial statistics has no counterpart to collect angler statistics. The nearest approach to a body of data is the 1970 saltwater angling survey reported by Deuel (1973) in which, unfortunately, the area considered in the present discussion is split between two regions: North Atlantic and Middle Atlantic. For the present purpose, data for the North Atlantic Region (New England and New York) will be examined.

The number of saltwater anglers in the region at the time of the survey (1970) was estimated to be 1.7 million persons. Alperin (1966) had estimated that 1.2 million saltwater anglers fished New York's waters in 1965, and Schaefer (1968) estimated the number would increase to 1.5

TABLE 2. ANGLER CATCH OF CERTAIN MARINE FISHES IN THE NORTH ATLANTIC REGION, 1970\*

| Species           | Number<br>(millions) |        | Percentage<br>taken from<br>the ocean | Weight<br>(metric tons) |        |
|-------------------|----------------------|--------|---------------------------------------|-------------------------|--------|
|                   | Ocean                | Other‡ |                                       | Total                   | Ocean  |
| Atlantic cod      | 3.1                  | 0.6    | 84                                    | 16,222                  | 13,626 |
| Silver hake       | 0.1                  | 0.3    | 25                                    | 299                     | 75     |
| Striped bass      | 0.5                  | 3.8    | 12                                    | 20,838                  | 2,500  |
| Scup              | 0.7                  | 2.2    | 24                                    | 1,044                   | 250    |
| Atlantic mackerel | 12.6                 | 20.9   | 38                                    | 18,855                  | 7,165  |
| Winter flounder   | 2.9                  | 18.6   | 13                                    | 11,220                  | 1,459  |

\* From Deuel (1973).

‡ Includes sounds, bays and rivers.

million by 1970. The National Marine Fisheries Service reported that, in 1970, each angler contributed an average of \$146 to the local economy in purchases of bait, gasoline, lodging, tackle and so forth. Thus, New York's recreational fishery in 1970 was worth \$219 million. There is, of course, no way to put a dollar figure on the recreational value each angler derived from his sport.

The author has attempted to analyze the data for 1970 as given by Deuel (1973) to get some estimate of the angler catch from the offshore portion of the North Atlantic Region (Table 2). First, the percentage of fish reported by anglers as caught in the ocean was calculated. Then, using the total weight reported for each species, the percentage, by weight, caught in the ocean was calculated. Thus, for 1970, the reported angler catch of these species from the ocean was estimated to have been 25,075 metric tons. At an average retail price of, say, 50 cents per kilogram (\$1.10 per pound), this catch would have been worth \$12.5 million as food.

The area surveyed for petroleum sediments includes the site of the famous Cox Ledge recreational cod fishery (Jensen, 1972, 1974b). Open and charter boats from Montauk (N.Y.), as well as from Massachusetts, Rhode Island and Connecticut, steam out daily on a nearly year-around basis to various parts of the ledge. As many as 60 anglers fish from the larger boats (e.g., the *Viking Star* or *Peconic Queen*, 31.7 meters and 30.5 meters, respectively, out of Montauk). This fishery obviously has great recreational value; some anglers drive from Pennsylvania and New Jersey to take part. The catch per trip of cod for the larger boats, for example, is estimated at 1.5 metric tons with occasional trips of 5 metric tons (Jensen, 1974b).

#### RISK POTENTIAL FROM SPILLS OFFSHORE

The probabilities of offshore spills stranding on Long Island calculated in the report of the Council on Environmental Quality (1974) were

based on reported studies of the surface and bottom currents. Bumpus (1965) analyzed the returns of sea-bed drifters in the Middle Atlantic Bight and concluded that the near-shore drift was westerly or southerly with some drifters moving to the coast. There was marked drift toward the mouths of estuaries such as the mouth of the Hudson River.

The Sandy Hook Laboratory (1972) reported that workers there had launched surface and sea-bed drifters in the New York Bight in 1969. The return rate was high: 26 per cent for the surface drifters and 32 per cent for the sea-bed drifters. The laboratory personnel reached the following conclusions with regard to water circulation in the New York Bight.

1. There was a substantial shoreward migration of both surface and sea-bed drifters.
2. The data suggest that there is a strong flow at the bottom into the mouth of the Hudson estuary.
3. There was some indication of a general clockwise circulation in the New York Bight.
4. There was only a mild seasonal variation in the bottom patterns, but the surface patterns suggested a strong seasonality. In the winter, surface flow appeared to be mostly southeastward. At other times, the water currents tended to flow northward onto Long Island.

The data from the drifter studies strongly suggest that any materials spilled into the Atlantic Ocean in and around the Baltimore Canyon Trough would soon move shoreward into the near-coastal waters and eventually fetch up on the beach. The spilled materials would have a direct impact on the marine organisms in the local waters.

#### EFFECTS ON MARINE ORGANISMS

It is common to think of marine organisms only in their adult stages, when they are caught and used for food. Of greater importance, however, are the early life stages upon which the ultimate success of the fisheries depend. With only a few exceptions, the species discussed in this paper spawn, and their larvae develop, in the area considered here (Perlmutter, 1939; Bigelow and Schroeder, 1953). Some of the species are demersal spawners, but their eggs and larvae are pelagic. With others, the larvae, at least, are found at all depths. Thus, the early stages as well as the adults are vulnerable to environmental contaminants throughout the water column.

Some problems that derive from petroleum operations and how they might affect New York's marine environment have been discussed at a

number of local conferences (Jensen, 1971a, 1971b). It was early established that we do not know what the long-term effects of oil spills in the marine ecosystem may be. Answers are needed as to the possible role of oil in the water column, especially the residuals after mop-up or even after evaporation of the volatile fractions has taken place. Surface films of oil may interfere with the diffusion process of the air-sea interface. The build-up of residuals on or in the marine substrate may adversely affect the infauna.

The impact of oil as a pollutant of marine organisms was reviewed by Halstead (1970). The immediate short-term effects are obvious and have been well described in the literature. However, some of the most serious effects are those that result from low-level, long-term (i.e., chronic) exposure. The hydrocarbons are stable, and once they enter the food web they persist and may be concentrated as they pass upward through the trophic levels. They behave, says Halstead (1970), similarly to chlorinated pesticides and some of the heavy metals and may be concentrated to the point where they become toxic to the organisms.

Most of the research on the toxicity of petroleum to marine organisms has been concerned with acute effects, i.e., those that might arise from catastrophic spills of large magnitude. However, Evans and Rice (1974) emphasized that chronic, low-level oil impact is potentially more damaging to ecosystems than the catastrophic spills. The decision makers are forced to rely on interpretative judgments rather than on judgments with a sound foundation of hard data. Adding to the problem is the web of elements that are involved. Thus, they pointed out, "The impact of oil on the marine environment is governed by several factors—physical, chemical, and biological—in addition to the inherent complexity of crude oil and refined products."

The damage to organisms whose environment has been polluted by crude oil and oil fractions was summarized by Blumer (1970) and reviewed by Evans and Rice (1974) as follows:

1. Direct kill of organisms through coating and asphyxiation.
2. Direct kill through contact poisoning of organisms.
3. Direct kill through exposure to the water-soluble toxic components of oil at some distance in space and time from the accident.
4. Destruction of the generally more sensitive juvenile forms of organisms.
5. Destruction of the food sources of higher species.
6. Incorporation of sublethal amounts of oil and oil products into organisms (resulting in reduced resistance to infection and other stresses—the principal cause of death in birds surviving immediate exposure to oil).

7. Incorporation of carcinogenic and potentially mutagenic chemicals into marine organisms.
8. Low-level effect that may interrupt any of numerous events (such as prey location, predator avoidance, mate location or other sexual stimuli, and homing behavior) necessary for the propagation of marine species higher in the marine food web.

In addition to the toxic effects of petroleum, there are also the esthetic effects whereby the oil imparts tastes and odors to organisms used as human food. This is particularly important to New York's valuable hard clam fishery which supplies approximately 53 per cent of the clams that are harvested in the United States. Any unpleasant taste or odor, no matter how slight, could be expected to turn consumers away from the product. This also could be expected with finfish. Indeed, for decades, anglers have complained that striped bass caught in the New York City portion of the Hudson River were inedible and "smelled like old rubber boots fried in kerosene" when they were cooked.

There is further consideration beyond the biology and economics of the marine resources. In my opinion, we must also consider the social impact on a global scale of any exploitation of possible petroleum reserves in the Outer Continental Shelf off the East Coast. While the United States retains control of the resources of the sea bed, it does not operate alone on the sea surface. We share the fishery resources of the area with more than a dozen nations. Many of them depend on the fish as an important source of protein food. Thus, in our management plans for the fishery resources, we have an obligation to insure that exploitation for petroleum resources will not be detrimental to the fishery resources.

### CONCLUSIONS

In any discussion of the resources of the marine environment, we must consider them in relation to the ecosystem of which they are a part. None exists in a vacuum. Thus, the finfish should not be considered apart from the petroleum resources. Man, as an exploiter of the resources, must also be reckoned with.

The decision makers responsible for the conservation (that is, wise use) of our marine resources face no easy task in the consideration of offshore drilling. It is possible that gas, not oil, will be found and that there will be little chance for oil pollution in the sea. If oil is found, it is possible that the technology then available will insure that none will spill on the sea. It is possible, too, that the various structures above and below the surface will not interfere with trawling, navigation and other marine activities.

All of these are possibilities. The only certainty is that, if we must

weigh one marine resource against another, the fishery resources—their extent and value—are known, whereas the petroleum resources are unknown.

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# CANINE DISTEMPER IN WILD CARNIVORES IN NEW YORK

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## ABSTRACT

During 1972, a total of 416 specimens of wild carnivores, principally gray foxes, red foxes, raccoons and skunks, from locations throughout the State were submitted to the Wildlife Research Laboratory at Delmar for necropsy. Most had been found dead or appeared to be sick. Canine distemper was diagnosed and confirmed histologically in 251 (60.3 per cent) of these specimens. Cases were encountered throughout the year with a peak in early spring. Distribution of the affected animals was statewide. The findings indicate that the effects of canine distemper on small-carnivore populations may well be significant. The disease, in addition to direct mortality, seems to increase mortality by traumatic causes due to alterations of the nervous system. As populations increase, canine distemper appears to be a limiting factor. Keeping populations at levels low enough to minimize virus transmission can be done by using these species as a fur resource.

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Canine distemper, a major disease problem in domestic dogs, has, in recent years, also become a problem among wild carnivores. Outbreaks of canine distemper have occurred at zoos and menageries for a number of years. Chaddock (1948) listed it as the cause of death of 210 foxes from 2,482 specimens necropsied from a variety of fox farms. During the 1950's natural outbreaks in wild animals were recorded in Kansas (Menges et al., 1955), Connecticut (Helmboldt and Jungherr, 1955) and Indiana (Robinson et al., 1957). The purpose of the present paper is to record the current status of this disease in wild carnivores in New York State.

## MATERIALS AND METHODS

During 1972, a total of 416 specimens of wild carnivores of various species from locations throughout the State were submitted to the Wildlife Research Laboratory at Delmar by conservation officers, fish and wildlife technicians, trappers, hunters and other concerned members of the public. Except for some of the red foxes, these were animals that had been found dead or moribund or that the collector believed were sick. All were completely necropsied.

Canine distemper was diagnosed by the presence of typical viral inclusion bodies in epithelial cells. Bladder epithelia was scraped off, smeared onto a slide and fixed in methyl alcohol for 30 seconds. The slides were stained by two different techniques. All bladder scrapings were stained

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with Shorr's inclusion body stain. Duplicate smears from many of the animals were stained with Seller's stain (basic acid fuschia and methylene blue). Tracheae, bile ducts and conjunctivae from many animals were also scraped and stained. Several of the earliest diagnoses were confirmed by the rabies laboratory of the New York State Department of Health using Seller's stain on conjunctival epithelium. Tests for rabies were performed by the State Department of Health on all animals submitted.

## RESULTS

Canine distemper was diagnosed in 251 (60.3 per cent) of the 416 specimens examined. Table 1 shows the distribution of the positive cases by species and county. Table 2 shows the percentage of positive cases for each species. The pathology observed varied slightly from species to species. Most of the affected animals of all species showed coryza, lung involvement and splenomegaly. Other frequently seen gross pathology included enteritis, cystitis and pale hypertrophy of the kidneys with hemorrhaging along the cortico-medullary line. Skunks typically showed blistering of the skin of the nose, ears, anal region and feet. Raccoons almost invariably showed cystitis and cloudy, pussy urine. Red foxes were more apt to show hematuria than other species. Many foxes and raccoons had empty stomachs, although a few individuals had stomachs containing swallowed blood.

Animals which were first seen alive showed extensive behavioral aberrations. Wandering, circling, confusion and a staggering gait were often noted. Affected animals were typically lethargic. Most of the seriously affected animals had lost their innate fear of man and were readily approached or even walked toward humans. This was often interpreted as aggression. As with canine distemper in dogs, the later stages were characterized by posterior ataxia and intermittent convulsions.

## DISCUSSION

The comparatively low incidence of canine distemper in the red foxes examined (Table 2) may be partially accounted for by the fact that numerous red foxes that had been trapped and pelted were submitted as part of an on-going study of fox ecology in central New York. The majority of these animals were healthy when trapped. In addition, sarcoptic mange appears to be keeping red fox populations in much of the State at a level low enough to avoid massive die-offs from canine distemper (Stone et al., 1972).

Budd (1970) indicated that published reports were not available to confirm the incidence of canine distemper in otters or fishers. In the present study, five cases were found in fishers, as indicated by the presence of inclusion bodies. Two otters and six weasels were examined with-

TABLE 1. DISTRIBUTION OF CONFIRMED CASES OF CANINE DISTEMPER IN WILD CARNIVORES EXAMINED FROM NEW YORK IN 1972, BY COUNTY AND SPECIES

| County      | Gray fox | Red fox | Raccoon | Skunk | Mink | Wild canid | Fisher | Total |
|-------------|----------|---------|---------|-------|------|------------|--------|-------|
| Albany      | 8        | ..      | 39      | 13    | ..   | ..         | ..     | 60    |
| Allegany    | ..       | 1       | ..      | ..    | ..   | ..         | ..     | 1     |
| Bronx       | ..       | ..      | 1       | ..    | ..   | ..         | ..     | 1     |
| Cattaraugus | 2        | ..      | ..      | ..    | ..   | ..         | ..     | 2     |
| Cayuga      | 10       | 13      | ..      | 2     | 1    | ..         | ..     | 26    |
| Chemung     | ..       | ..      | ..      | ..    | 1    | ..         | ..     | 1     |
| Columbia    | 4        | ..      | 1       | 3     | ..   | ..         | ..     | 8     |
| Cortland    | ..       | ..      | 2       | ..    | ..   | ..         | ..     | 2     |
| Delaware    | 2        | ..      | 3       | ..    | ..   | ..         | ..     | 5     |
| Dutchess    | 6        | ..      | 3       | 2     | ..   | ..         | ..     | 11    |
| Essex       | ..       | 1       | 1       | ..    | ..   | ..         | ..     | 2     |
| Franklin    | 1        | ..      | ..      | ..    | ..   | 1          | 5      | 7     |
| Greene      | ..       | ..      | 2       | ..    | ..   | ..         | ..     | 2     |
| Hamilton    | ..       | ..      | 1       | ..    | ..   | ..         | ..     | 1     |
| Herkimer    | ..       | 1       | ..      | ..    | ..   | ..         | ..     | 1     |
| Jefferson   | ..       | ..      | 2       | ..    | ..   | ..         | ..     | 2     |
| Nassau      | ..       | ..      | 3       | ..    | ..   | ..         | ..     | 3     |
| Onondaga    | 2        | ..      | ..      | ..    | ..   | ..         | ..     | 2     |
| Ontario     | 1        | 2       | ..      | ..    | ..   | ..         | ..     | 3     |
| Orange      | 2        | ..      | ..      | ..    | ..   | ..         | ..     | 2     |
| Oswego      | ..       | ..      | 1       | ..    | ..   | ..         | ..     | 1     |
| Otsego      | ..       | ..      | 1       | ..    | ..   | ..         | ..     | 1     |
| Putnam      | 2        | ..      | 1       | ..    | ..   | ..         | ..     | 3     |
| Rensselaer  | 3        | 1       | ..      | 8     | ..   | ..         | ..     | 12    |
| Saratoga    | ..       | ..      | 3       | ..    | ..   | ..         | ..     | 3     |
| Schenectady | ..       | ..      | 2       | ..    | ..   | ..         | ..     | 2     |
| Schoharie   | 2        | ..      | 3       | ..    | ..   | ..         | ..     | 5     |
| Schuyler    | ..       | ..      | ..      | 1     | ..   | ..         | ..     | 1     |
| Seneca      | ..       | 1       | 1       | ..    | ..   | ..         | ..     | 2     |
| Suffolk     | ..       | 1       | 1       | ..    | ..   | ..         | ..     | 2     |
| Sullivan    | 26       | 1       | 8       | ..    | ..   | ..         | ..     | 35    |
| Tompkins    | ..       | ..      | 1       | ..    | ..   | ..         | ..     | 1     |
| Ulster      | 1        | 1       | 4       | ..    | ..   | ..         | ..     | 6     |
| Warren      | ..       | ..      | ..      | 2     | ..   | 1          | ..     | 3     |
| Washington  | ..       | ..      | 1       | ..    | ..   | ..         | ..     | 1     |
| Wayne       | 12       | 17      | ..      | ..    | ..   | ..         | ..     | 29    |
| Westchester | ..       | ..      | 1       | ..    | ..   | ..         | ..     | 1     |
| Yates       | ..       | 1       | ..      | ..    | ..   | ..         | ..     | 1     |
| Total       | 84       | 41      | 86      | 31    | 2    | 2          | 5      | 251   |

TABLE 2. FREQUENCY OF POSITIVE CASES OF CANINE DISTEMPER IN WILD CARNIVORES EXAMINED FROM NEW YORK IN 1972, BY SPECIES

| Species    | Number examined | Positive cases |          |
|------------|-----------------|----------------|----------|
|            |                 | Number         | Per cent |
| Gray fox   | 131             | 84             | 64.1     |
| Red fox    | 133             | 41             | 30.8     |
| Raccoon    | 99              | 86             | 86.9     |
| Skunk      | 37              | 31             | 83.8     |
| Mink       | 3               | 2              | 66.7     |
| Wild canid | 3               | 2              | 66.7     |
| Fisher     | 10              | 5              | 50.0     |
| Total      | 416             | 251            | 60.3     |

out finding indications of the disease. Two mink and two wild canids (eastern coyote) were also found to be affected by canine distemper. One eastern timber wolf was found to have distemper, but the animal was a captive and so was not included in the data presented here.

Populations of the gray fox, raccoon and skunk were high in New York State in 1971. An initially high gray fox population in Sullivan County in February 1972 was noted by field personnel to be much reduced by the following July after considerable losses to canine distemper.

Distribution of the virus was statewide, the variability in numbers of specimens being due to variations in the numbers of persons in the field collecting them. Nor was incidence limited seasonally. Cases occurred throughout the year although there was a peak in the early spring (March-April). Gorham (1966) cited several variations in seasonal incidence including peaking in winter-early spring.

It appears that canine distemper will occur during any season as long as there are sufficient numbers of susceptible hosts. Mortality from the disease has been reported to vary from 50 per cent for raccoon (Budd, 1970) to 90 per cent for dogs with neurological symptoms (Gorham, 1966). The present study indicated a fatality of about 98 per cent in carnivores that were not euthanized. In a wild population, then, there should be little natural immunity. Therefore, a susceptible population should be always available. Occurrence of canine distemper would then be related mainly to population densities.

Transfer of the virus remains a matter for discussion. Direct contact and aerosol are proven means of transmission for the canine distemper virus. Infection through urine or feces contamination has not been proved. Gorham (1966) was unable to induce infection by an oral route. Another possibility for transmission was suggested in the present study. One experimental ferret that died of canine distemper was a pregnant female. Smears from the brains, bladders and tracheae of the partially furred fetuses were stained with Shorr's stain. All showed canine distemper inclusion bodies.

Pathology noted in the specimens examined during this study agreed quite closely with that published for the species involved. Raccoons, red foxes, gray foxes and skunks commonly had conjunctival discharging and coryza. Lung involvement and splenomegaly were the rule in all species, as were neurological symptoms. Robinson et al. (1957) listed typical signs of canine distemper in raccoons as "abnormal social habits, emaciation, ocular and nasal discharge, chorea, blindness, paralysis and other nonspecific neurological disturbances". The present findings differed from these in that emaciation was seldom seen.

Mech et al. (1968) found pustular dermatitis in several juvenile raccoons affected with canine distemper. Dermatitis of variable severity was

noted in a few raccoons and skunks in the present study. Most lesions were localized on the face, limbs and chest and in the anal region. In a few cases it was noted that the hair slipped easily on fresh carcasses. This was presumably due to poor circulation caused by endothelial damage. Skunks were the most apt to show blistering of the face, nose and lips.

Kilham and Herman (1954) noted bilirubinemia and jaundice in sick raccoons which were later determined to have canine distemper (Kilham et al., 1956). Jaundice was noted in the present study in red foxes but not extensively in raccoons or other species. Enteritis was also more often seen in foxes than in raccoons or skunks. Raccoons were the most likely to show cystitis.

The most obvious signs in a living animal are those of neurological disorder. Over 100 of the 251 canine distemper cases were animals which were alive when first found. These animals showed behavioral aberrations ranging from lethargy to aggression. Most so-called aggression was attributable to lack of fear of humans and other animals. Several affected raccoons and foxes had porcupine quills embedded in the wall of the stomach. Usually, affected animals were easily approached and put up little struggle when captured. They ate and drank when food and water were offered but made no attempt to find the food or water.

Intermittent spasms or epileptiform seizures appeared in the later stages of the disease in raccoons. During such seizures, the jaws snap convulsively, the hind legs may become rigid and the animal often lies on its back. Frothing at the mouth and these "careless" jaw movements in many cases suggested rabies to the persons finding the animals. After the seizure stage, raccoons typically go into a deep sleep from which they are roused with great difficulty. Gray foxes go into a terminal coma.

Only four of the raccoons diagnosed as having canine distemper recovered. These were animals that at first had only mild seizures. Animals which reached the comatose stage were euthanized.

Canine distemper can be an important mortality factor in wild carnivore populations. The quantitative effect of an epizootic on a population is difficult to assess because there are seldom quantitative census data available on the original population. Nor is there an easy means available to census small carnivores. However, if we accept the subjective but experienced judgment of field personnel directly involved, a great effect on local populations can be seen. Robinson et al. (1957) indicated, also without figures, that the raccoon population in Indiana was noticeably reduced in some areas due to the disease while remaining relatively unaffected in other areas of the state. In addition to direct mortality from the disease, virus-caused abnormal behavior accounts for the loss of additional animals. Affected animals are more likely to become highway fatali-

ties than are alert healthy individuals. Numerous other diseased animals are shot because of their abnormal behavior.

Control of canine distemper in wild carnivore populations is necessarily limited to keeping populations at levels low enough to minimize virus transmission. This can be done by using them as a fur resource. Raw fur prices have increased in the past few years. This should increase trapping and encourage efficient use of the resource while maintaining healthy populations of these species.

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# POTASSIUM PERMANGANATE DEMAND OF A STREAM BOTTOM<sup>1</sup>

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## ABSTRACT

During rotenone treatment of a deep-outlet reservoir, the largely organic bottom of the outlet stream exerted a potassium permanganate demand independent of that of the outlet water. This demand reached a maximum when the water was heavily loaded with detritus from decaying fish and returned to approximately its original value after the onset of the fall overturn. When rotenone detoxification with potassium permanganate is planned for any stream or pond outlet having a mud or silt bottom, it is recommended that an *in situ* measurement of the total potassium permanganate demand be made. Techniques for making this measurement are described.

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Controlled detoxification of rotenone or antimycin with potassium permanganate requires accurate determination of potassium permanganate demand, i.e., the amount of potassium permanganate reduced by naturally occurring materials during the detoxification period. The usual practice is to obtain a sample of water from the stream or pond outlet to be treated, determine its potassium permanganate demand over the projected detoxification contact time, using either a spectrophotometer or a color comparator (Engstrom-Heg, 1971), and add half of this figure to the potassium permanganate concentration needed to obtain detoxification in the given contact time (Engstrom-Heg, 1972). This procedure has proved satisfactory in laboratory tests, and in field tests conducted in streams flowing over predominantly inorganic bottom materials. It has been hypothesized, however, that it might not be satisfactory for a sluggish, mud-bottomed stream in which the substrate might exert a significant potassium permanganate demand independent of that of the water. Rotenone treatment of Lebanon Reservoir, in Madison County (N.Y.), in September 1973 provided an opportunity to test this hypothesis.

Lebanon Reservoir, occupying 110 acres, drains through a deep outlet at the base of a dam into Kingsley Brook, a small but productive trout stream. The outlet, controlled by two valves, empties through a concrete tunnel into a basin-shape pool approximately 40 feet in diameter and having a maximum depth of about 3 feet at low flow. After eddying through this pool, the current enters a channelized section of stream approximately 1,000 feet long having a sluggish to moderate current and an abundant growth of rooted aquatic plants. In both the pool and the channelized reach, the bottom consists largely of mud and angular rubble having a rather heavy growth of periphyton.

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<sup>1</sup>A contribution of Federal Aid in Fish and Wildlife Restoration Project F-9-R.

On September 24-26, 1973, Department of Environmental Conservation personnel treated Lebanon Reservoir with 0.7 ppm of 5 per cent emulsifiable rotenone to eliminate an excessive population of yellow perch and small centrarchids prior to restocking the reservoir with brown trout and rainbow trout. Before this treatment, it was decided that a small flow would be maintained in Kingsley Brook to protect the downstream trout population and to provide drinking water for livestock on adjoining farms. This flow was to be treated with potassium permanganate at a concentration sufficient to detoxify the rotenone in 20 minutes. The potassium permanganate in turn was to be reduced to manganous ions with sodium thiosulfate at a downstream point. Prior to treatment, the reservoir was drawn down a total of 8 feet, thus removing a large volume of hypolimnetic water. On September 24, the outlet discharge was cut back to 0.155 cubic foot per second just before the introduction of rotenone. On this date, reservoir temperatures were 66° F. above a 30-foot thermocline and 59° F. at a depth of 41 feet and at the outlet. The outlet water had a total alkalinity of 100 ppm, a pH of 7.5 and a 20-minute potassium permanganate demand of 0.3 ppm, practically all of which occurred during the first 5 minutes, indicating the presence of a rapid reducing agent.

On September 25, the potassium permanganate influx from a 13-gallon Mariotte bottle placed near the head of the outlet pool was adjusted to give an initial concentration of 3.1 ppm which was calculated to give 20-minute detoxification. Sodium thiosulfate was introduced at 4.7 ppm from a second Mariotte bottle located 100 feet downstream. Mean stream travel time, as estimated by salt-tracer techniques, using a conductivity meter, was 24 minutes from the potassium permanganate station to the pool outlet and 30 minutes to the sodium thiosulfate station. Treatment of the outlet was continued through 22 days to October 16. The potassium permanganate and sodium thiosulfate concentrations were adjusted from time to time to correspond with changes in the potassium permanganate demand and in the remaining rotenone concentration at the reservoir outlet as determined by bioassay, using the method of Loeb and Engstrom-Heg (1971).

On September 27, residual potassium permanganate concentrations were measured at points estimated to be 7.5, 24 and 30 minutes mean stream travel time from the potassium permanganate source. Determinations were made with a chlorine color comparator, following the field method described by Engstrom-Heg (1971). Although the method used could not be expected to yield a high level of precision, the essential pattern was quite clear as shown in Figure 1. It was apparent that reduction to tetravalent manganese was occurring at a rate in excess of that predicted from the potassium permanganate demand of the water, that

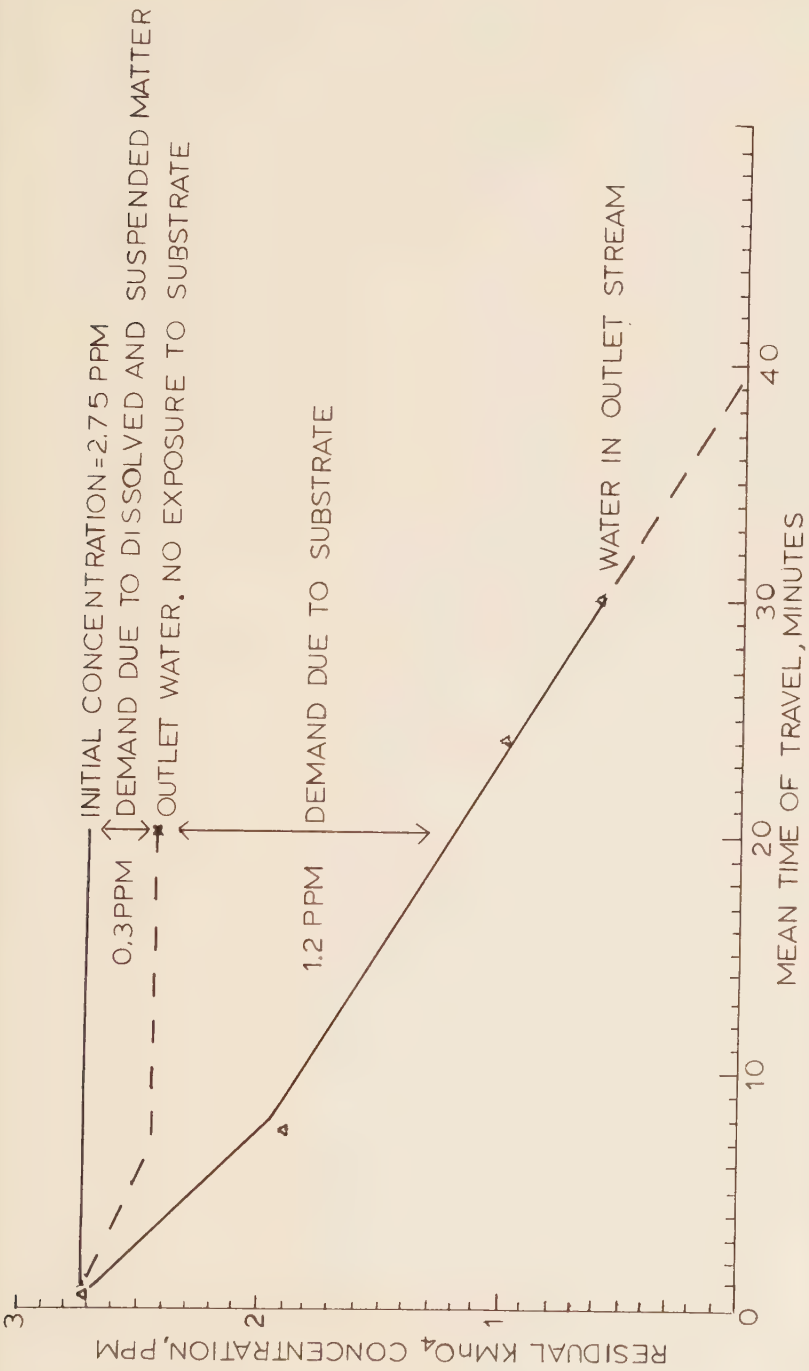


Figure 1. Potassium permanganate demand in Lebanon Reservoir Outlet on September 27, 1973.

the reduction extended over a longer period and that the final concentration of potassium permanganate was lower than predicted. These conclusions were supported by the gradual change in color of the water from light purple to dull orange-brown between the potassium permanganate source and the sodium thiosulfate station. Total potassium permanganate demand over a 20-minute period was estimated to be 1.5 ppm, of which 0.3 ppm was attributable to the water and 1.2 ppm to the stream bottom.

Rotenone concentration in the outlet water reached a maximum of 1.0 ppm of 5 per cent emulsifiable product on September 30. Soon thereafter, decay products from dead fish began to accumulate in the hypolimnion, giving the outlet water a distinctly foul odor and somewhat turbid appearance. By October 4, the potassium permanganate demand of the water had increased to an estimated 0.9 ppm. On this date the initial potassium permanganate concentration was 4.6 ppm, and the residual concentration at the foot of the pool was 1.0 ppm. By linear interpolation, the 20-minute residual concentration was 1.5 ppm, the total demand 3.1 ppm and the demand attributable to the stream bottom 2.2 ppm. It seems likely that this increase was largely due to particulate matter settling out on the pool bottom.

On October 5, the reservoir became thermally homogeneous at 58° F., and the fall overturn began. The outlet water suddenly cleared and changed character. Potassium permanganate demand was still present, but it was distributed over a longer time period and did not exceed 0.4 ppm.

On October 16, the last day of treatment, the initial potassium permanganate concentration was 3.85 ppm, and the residual concentration at the foot of the pool was 1.0 ppm. By linear interpolation, the 20-minute residual concentration was 2.2 ppm, and the total 20-minute demand was 1.65 ppm of which 0.4 ppm was attributable to the water and 1.25 ppm to the stream bottom. The demand of the stream bottom was thus comparable to that observed on September 27.

These findings clearly show that, where rotenone detoxification is planned for a stream or pond outlet having a largely organic bottom, it is essential to make an *in situ* measurement of the total potassium permanganate demand in addition to determining the potassium permanganate demand of the water. This may be done in the following manner.

1. Set up a potassium permanganate station and measure the stream discharge and the potassium permanganate demand of the water. Then begin introducing potassium permanganate solution at a concentration approximately equal to that needed to detoxify the rotenone in the desired time plus half the potassium permanganate demand of the water. The salt should be introduced at a rate equal

to 102 grams per part per million for each cubic foot per second of stream discharge.

2. Time the passage of the leading edge of the potassium permanganate to the projected detoxification point. Allow the potassium permanganate to run into the stream at a constant rate until three times this time period has elapsed. If there is no potassium permanganate demand, this will assure a steady-state concentration equal to the concentration at the introduction point.
3. Determine the residual potassium permanganate at the projected detoxification point as follows:
  - a. Collect a 20-milliliter sample from the stream, and dilute it to 100 milliliters with distilled water.
  - b. In a shaded location, add 0.5 milliliter of orthotolidine to the sample.
  - c. Place an aliquot of the sample in a residual chlorine color comparator and read the residual chlorine value.
  - d. Compute the residual potassium permanganate concentration according to the equation  $C_r = 9.5A - 0.74Co$

where  $C_r$  = residual potassium permanganate concentration

$Co$  = initial potassium permanganate concentration

$A$  = residual chlorine value of the sample.

this equation is a simplified form of the equation

$$C_r = Co \left( \frac{A - 0.427Ao}{0.57Ao} \right)$$

in which  $Ao$ , the residual chlorine reading corresponding to  $0.2Co$ , is assumed to be equal to  $0.183Co$  (Engstrom-Heg, 1971).

4. Compute the total potassium permanganate demand,  $D = Co + C_r$ .

If the total potassium permanganate demand is substantially greater than that of the water only, then half of the former, rather than half of the latter, figure should be added to the potassium permanganate concentration needed to detoxify the rotenone.

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# PREScribed BURNING FOR MANAGEMENT OF HAWTHORN AND ALDER<sup>1</sup>

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## ABSTRACT

A 1.3-hectare field containing hawthorn and alder was burned in April 1973. Post-burn analysis of 20 hawthorns and 20 alders determined the fire susceptibility of these species. Of those sampled, 80 per cent of the trees less than 3 centimeters in basal diameter were killed. The approximate age of those killed was calculated by comparison with basal diameters for known-age stems. Management alternatives from control to enhancement of hawthorn and alder are discussed.

Hawthorn (*Crataegus* sp.) and alder (*Alnus rugosa*) have been classed as weed species by foresters and range managers (Cope and Winch, 1971). However, wildlife values of these species are fairly high. Bump et al. (1947) and Schemnitz (1970) found the fruits of hawthorn to be an important fall food for the ruffed grouse (*Bonasa umbellus*). Sharp (in Gill and Healy, 1974) rated hawthorn as an important food for grouse, white-tailed deer (*Odocoileus virginianus*) and cottontail rabbits (*Sylvilagus floridanus*). Richmond and Rosland (1949) found that the smaller stems of hawthorn furnished an important food source for cottontail rabbits during the winter.

The value of alder as woodcock cover and feeding areas is well described by Sheldon (1967). Gill and Healy (1974) rated alder as a low-preference browse of moose (*Alces alces*), muskrat (*Ondatra zibethica*), beaver (*Castor canadensis*), cottontail rabbit, snowshoe hare (*Lepus americanus*) and white-tailed deer.

Most attempts to manage hawthorn and alder have relied heavily on various forms of herbicides such as 2,4-D and 2,4,5-T. Different dosages and combinations of these chemicals have been tried with a variety of methods and results (Gammon, 1949; Owens and Willard, 1954; Pavlychenko, 1952; Pavlychenko and Bestrop, 1953; Day and Dils, 1951; Morrow, 1954, 1955; Waywell, 1954; Nation, 1965).

Work in other areas of the United States has shown that controlled fire

<sup>1</sup>Contribution of the New York Cooperative Wildlife Research Unit, Cornell University, New York State Department of Environmental Conservation, U.S. Fish and Wildlife Service and Wildlife Management Institute cooperating. The study was undertaken as an undergraduate, independent research project at Cornell University. Criticism and assistance throughout the work were provided by Dr. Daniel Q. Thompson. Special appreciation is extended to Howard Edgreen for allowing the use of his land as a study area and to the author's father, Theodore C. Burgason, for assisting in many ways.

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can be a successful tool in the management of hardwoods (Dixon, 1965; Kennedy and Williams, 1963). The purpose of the present study was to investigate the possibility of using fire to manage the invasion of abandoned pastures by hawthorn and alder. Fire was felt to be more desirable than herbicides or cutting on the basis of a lower cost per acre, the ability to treat large areas in a short time and because fire is a more natural means of controlling succession without the possible adverse side effects of chemicals.

#### STUDY AREA

The study area was located in Pennsylvania 2 miles north of Port Allegany in McKean County and 16 miles south of Portville (N.Y.). The locality is in the Allegheny River flood plain and is typical of the unglaciated Allegheny Plateau section of the Appalachian Plateau described by Smith (1955). The area occupied 1.3 hectares (3.2 acres).

The topography is basically level except for the channels of two intermittent streams which pass through the area in a generally north-south direction. While no soil map was available, field analysis indicated the surface soil to be a sandy loam. Results of an analysis by the Cornell University Soil Testing Laboratory showed the soil to be well below average in soil nutrients.

Cattle grazing on the area ceased approximately 10 years before the study, and the area had been undisturbed since that time. Much of the hawthorn and alder was present at the time of abandonment. The alder was then restricted mainly to situations along the stream channels, but, following abandonment, it had gradually invaded parts of the area away from the streams.

Hawthorn was present in stands which had apparently been held by cattle browsing to a height of 3 feet or less. In this situation, ground cover had been abundant around the base of the hawthorns and provided excellent cover for cottontail rabbits which were heavily hunted. Following abandonment, the hawthorns began to grow rapidly so that at the time of the study many of these dense stands were 7 to 8 feet in height. Low light levels under such stands reduced the ground cover with a consequent reduction in the rabbit population.

The cover and its distribution at the time of the study are shown in Figure 1. Four vegetative types were recognized.

|      |                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Open | Woody vegetation was present as individual hawthorns and alders, generally less than 4 feet in height although some were as large as those occurring in the pure stands. Ground cover composed of various species of grasses was present at the base of all woody plants. Several species of goldenrod ( <i>Solidago</i> spp.) were also prevalent. Open areas comprised 59 per cent of the total area. |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Hawthorn** Hawthorn, in dense stands generally 5 to 8 feet in height that excluded most undergrowth, represented 2 per cent of the total area.

**Swale** Swales in the intermittent stream channels were filled with water during the spring and periods of high water but were generally dry during the summer. The predominant vegetation was a species of bulrush (*Scirpus* sp.). Swales comprised 13 per cent of the total area.

**Alder** Alder, in relatively pure, dense stands mostly over 8 feet in height that were largely devoid of undergrowth, occupied 26 per cent of the total area.



Figure 1. Cover map of study area. Swales contained water during the spring and acted as effective fire breaks. Grid interval was 10 meters; numerals represent serial numbers of grid lines.

## METHODS

Planned burning on the area was done in the spring, and observations on its effect on the hawthorn and alder were made during the following summer, fall and winter.

## BURNING

Burning was done in the early afternoon of April 13, 1973. The fuel on the area was quite dry. Ideally, the burning should have been accomplished a week or more earlier since a large amount of new herbaceous growth had a dampening effect on the fire. Trout lily (*Erythronium americanum*) constituted the most abundant species of herbaceous ground cover. The wind was approximately 5 to 10 miles per hour from the northwest and the air temperature was 70° F. The fire was controlled by eight volunteers using Indian pumps and fire swatters.

A line of fire was begun in the northwest corner of the area using a drip torch. From the corner, the fire was set along the border in a clockwise direction. In order to speed up the operation, the area was then crisscrossed to set additional lines of fire and to burn isolated spots.

## POST-BURN SAMPLE OF VEGETATION

A grid system was established to aid in sampling the vegetation and in cover mapping. A roughly north-south grid line was laid along the eastern border of the study area using numbered wooden stakes placed 10 meters apart. At marker No. 10 on this line, another line perpendicular to it was begun and extended until it intersected the intermittent stream course which formed the western boundary.

A sample of 20 hawthorns and 20 alders was located from a random drawing of 20 grid points. Once a grid point was located, the nearest hawthorn and the nearest alder were determined. If the point fell within a stand of trees, the nearest individual was selected to represent the stand. Separate measurements were taken on stems present before the fire and sprouts which followed the fire. Basal diameters of both old and new stems were determined by the use of calipers.

Measurements taken on old stems included: stand or point distribution; number of stems arising from a common root; height; basal diameter; and whether the stem was killed by or survived the fire. As the vegetation survey was completed in January 1974, the judgment as to the survival or death of the tree was based on the presence or absence of winter buds.

Point distribution was defined as an isolated individual hawthorn or alder found in an open area. Stand distribution was defined as a group of several hawthorns or alders growing in close proximity to each other. Stands were mapped as pure stands of hawthorn or alder with insufficient ground cover to support a fire.

Measurements of new sprouts included: number of new stems arising from the base of the old stem; height; basal diameter; degree of browsing; and agent of browsing.

#### AGE IN RELATION TO DIAMETER

Sample sections of hawthorn and alder stems were collected from an area adjacent to the study area in January 1974. The outside diameter of each stem was taken with calipers shortly after cutting.

Annual rings were counted to determine the age of each stem. First, a clean cut was obtained by cutting the section on a table saw. Then the surface of the cut was smoothed with coarse and finally fine sandpaper.

There was little difficulty in aging the alder. Most could be aged without the use of magnification. Hawthorn rings were very difficult to count and required the use of a binocular microscope and staining. The stain used, phloroglucinol, was dropped into the section with a pipette and allowed to remain for approximately 5 minutes or longer. The section was then destained in tap water for a brief period and allowed to dry. If the annuli were not distinct when dry, the surface was wetted with a drop of water.

#### RESULTS

The effect of the burning was assessed in terms of survival and the amount of subsequent sprout growth. The data were also related to the age of the trees involved.

#### SURVIVAL

The over-all kill of the trees examined was 60 per cent and 55 per cent for hawthorn and alder, respectively. There are three factors which would affect the impact of fire on an individual plant. The first factor is the susceptibility of the tree according to its basal diameter. Basal diameters were divided into five classes, and the percentage of kill in each class is shown in Figure 2. As would be expected, there was a lower survival in the smaller diameter classes. A second factor is the response of different species to fire. Chi-square analysis of the data showed no difference between hawthorn and alder at the 0.001 level of significance.

A third factor believed to affect tree survival is the intensity of the fire as determined primarily by the amount of fuel at the base of the tree. Unfortunately, time did not permit quantifications of the fuel available. It was noted, however, that the amount of fuel varied with the tree growth on the site. Open areas with little or no shade contained the largest amounts of fuel. Areas of dense growths of pure hawthorn or alder lacked sufficient fuel to carry a fire except on the very edge of the stand. For alders in point distribution, 71.4 per cent (10 of 14) of the trees checked

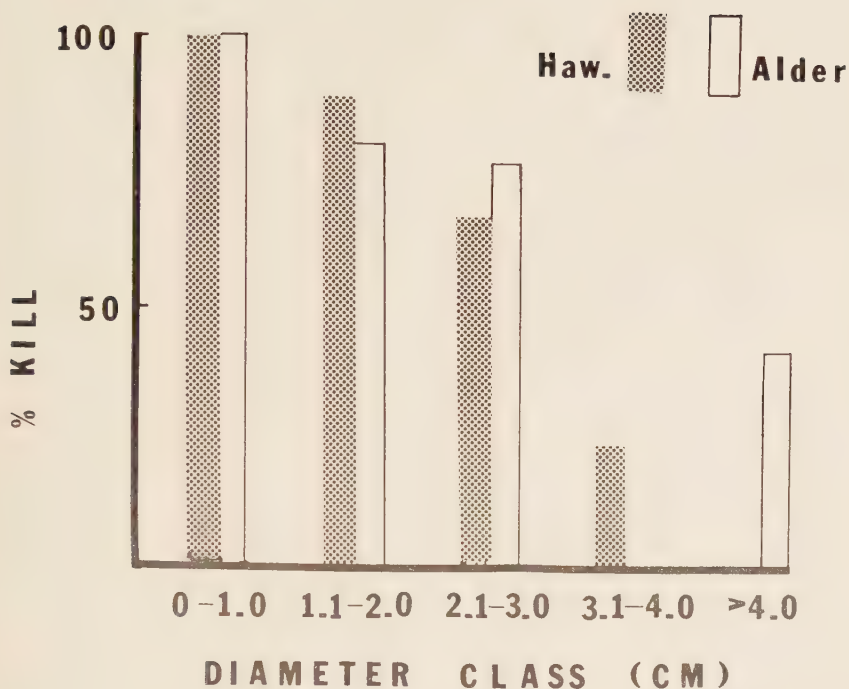


Figure 2. Percentages of hawthorn and alder killed by burn, according to diameter class.

were killed. Only 33.3 per cent (2 of 6) of the trees checked in stand distribution were killed. Results for hawthorn were similar: in point distribution 69.2 per cent (9 of 13) were killed, while in stand distribution 42.8 per cent (3 of 7) were killed. A chi-square analysis of the pooled data for hawthorn and alder did not give a statistically significant difference in survival ( $0.25 > P > 0.10$ ) although the small number of samples for stand distribution may have affected the results.

Sprouting appears to be a characteristic common to hawthorn and alder. In both species new sprouts originated on old stems at or within 5 centimeters of the ground surface.

In hawthorn, sprouting appeared to be a response to the death of the main stem. In all cases (12) where death of the above-ground portion of the stem was observed, there was subsequent sprouting. No sprouting was observed in trees which had survived the fire (8 cases). The number of new sprouts ranged from two to eight with a mean of 4.6 per stem. Mean diameter was 3.2 millimeters and mean height was 32 centimeters for the 55 sprouts measured. Browsing was very heavy on the hawthorn sprouts, some being observed as early as August 1973, only 4 months after the

burn. By January 1974, or 9 months after the burn, 46 of 55 sprouts (83.6 per cent) had been browsed by rabbits.

In alder, sprouting appeared to be independent of damage to the main stem. Observation of alders in an adjacent, unburned area showed sprouting from the base just as in alders killed by the fire. A total of 175 new sprouts were recorded from the 20 alders measured. Of these, 111 were from alders killed by the fire (mean of 10 per stem) and 64 were from surviving alders (mean of 8 per stem). Of burned and unburned alders, 90 per cent produced sprouts. Diameters ranged from 3 to 12 millimeters, and heights ranged from 22 to 120 centimeters. Of the 175 sprouts checked, 21 (12 per cent) had been browsed. The browsing animals were judged to have been deer in seven instances and rabbits in 14 instances.

#### DIAMETER IN RELATION TO AGE

The relationship of age to stem diameter was used to estimate the ages of the trees sampled in the burned area from the basal-diameter measurements recorded. The results are shown in Figure 3. A regression equation was calculated for hawthorn and alder using age in years as the inde-

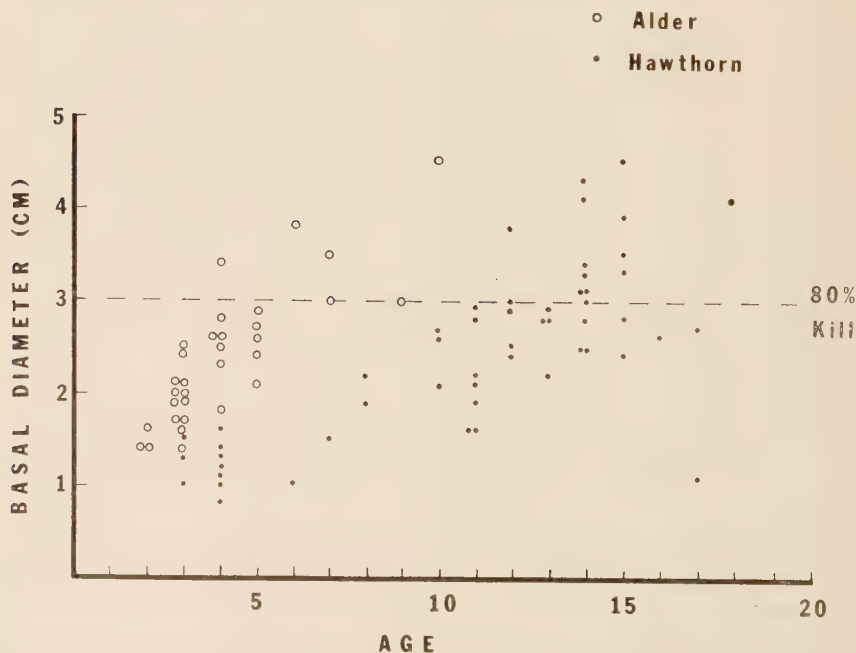


Figure 3. Relationship of basal stem diameter to age for hawthorn and alder. All samples were taken from tract adjacent to study area. Theoretically, 80 per cent of trees below line at 3 centimeters would be killed by first burn.

pendant variable ( $X$ ) and basal diameter in millimeters as the dependent variable ( $Y$ ). For hawthorn:  $Y = 1.43 + 2.22X$ ; and for alder:  $Y = 11.11 + 3.11X$ .

### DISCUSSION

In a given situation, management objectives for a woody species represent some point along the continuum from total elimination to enhancement of the species. Controlling the spread of hawthorn and alder by the use of fire is dependent on achieving a satisfactory kill of the main stem and establishing the proper fire periodicity. From the data presented here and in other papers, it seems unlikely that eradication would be possible, mainly because of the sprouting ability of these species.

Swan (1966), in his studies of accidental spring fires in south-central New York, found results similar to those of this study. Of 123 hawthorn saplings examined, he reported a 69 per cent kill, and 96 per cent of those killed or injured produced sprouts. Average sprout production was 4.7 per stem for saplings under 10 centimeters dbh. Swan pointed out that infrequent fire results in only a 10 to 23 per cent complete kill of all species of invading saplings. The rest produce dense clusters of sprouts which in 2 years create much shade and competition for other field plants.

Beckwith (1954) classed hawthorn as fire resistant in his studies of fields in Michigan. Infrequent accidental fires only slowed the change to forest. Baker (1968), working with controlled burning on old fields in New York, reported only two hawthorns within his study plots. Both were killed, yet both produced sprouts. No indication of size was given.

Preventing the domination of old fields may be possible by maintaining hawthorn and alder at a size at which they may be controlled by periodic burning. Kennedy and Williams (1963) reported that elm, persimmon and hawthorn were resistant to fire in the southeastern United States. They stated that their objective was primarily to keep hardwoods at a size where they could be controlled by prescribed burning. Comparing fire with herbicides, they concluded that fire was at that time the least expensive method available for removing understory hardwoods from conifer plantations.

Other studies have measured the effects of only one fire on trees. However, management of hawthorn and alder may be possible with the periodic use of controlled burning. The question then arises as to what is the necessary periodicity. Of all the trees measured that were less than 3 centimeters in basal diameter, 77 per cent of the hawthorns and 82 per cent of the alders were killed. Assuming this to be a satisfactory degree of kill, the substitution of 30 millimeters in the regression equations indicates that burning every seven years for hawthorn and every nine years for alder would keep these species at a size where they could be maintained in an early-successional stage. For hawthorn, this may be a valuable

method of producing browse and cover for cottontail rabbits and deer. Those that did survive would provide apples for grouse and songbirds. The periodicity proposed assumes that the first fire would not significantly alter the growth rate or response of the trees to future burns. Further study will be required to determine the validity of these conclusions.

Recent results of experimental burns on upland soils in the vicinity of Ithaca, New York (D. Q. Thompson, unpublished, N.Y. Fed. Aid Proj. W-127-R) show that hawthorn was not able to withstand two successive spring burns. The parent plants (3 to 4 centimeters in basal diameter) were killed by the first burn, and the entire root crowns with surviving sprouts were killed in a burn the following spring. Since surface fuel from grasses and forbs was relatively abundant on the Ithaca experimental sites, it is possible that less productive soils might not produce enough fuel to sustain successive annual burns.

Fire may also be used to encourage the reproduction of woody species either by burning once or at long intervals to stimulate root suckering or seedling establishment. Swan (1966) concluded that, in central New York, fires occurring at 10-year intervals or less often did not hinder the spread of aspen (*Populus* sp.) into fields but may actually have stimulated their spread by increasing sprouting.

By selecting the periodicity of fire to be used, the game manager or landowner can encourage or discourage hawthorn and alder or other woody species with similar response. Fire can achieve results comparable to those obtained with herbicides, and it is inexpensive enough to be used at more frequent intervals without the associated environmental risks.

Finally, it is important to note that all recommendations for the use of prescribed fire must recognize the limitations of air pollution burdens. Realistically, wildlife managers can only expect to use prescribed burning if regional air pollution burdens are minimal and if continuing investigations reveal that smoke from old fields is indeed innocuous.

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# FISH HEMATOLOGY, ITS USES AND SIGNIFICANCE<sup>1</sup>

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## ABSTRACT

Fish hematology is a useful tool of the ichthyologist and fishery biologist as an indicator of the physiological condition of experimental and hatchery fish stocks. It may be especially useful in assessing the status of nutrition, diseases and parasites, and stress due to changing environmental conditions. There is a need for determining normal hematological values under a wide variety of natural and experimental conditions, as these normal values must be known in order to recognize a pathological state. Also, procedures and techniques in hematological investigation, as well as methods for reporting, need to be more thoroughly standardized.

In recent years fish hematology has become an increasingly important tool of fishery biologists and research ichthyologists. Its uses are many and varied and may offer a reliable indication of physiological well-being. At present, one or more of four basic parameters are most often used: the hematocrit (packed cell volume) expressed as the percentage of erythrocytes by volume, hemoglobin content, erythrocyte and leucocyte numbers. To a lesser extent are used the osmotic fragility test and the differential leucocyte count which employs the staining and identification of the various types of leucocytes.

## USES IN FISHERIES MANAGEMENT

Fishery biologists employ hematological procedures to assess the condition of their fish stocks as well as the adequacy of artificial fish diets. Katz (1950) stated that "blood counts help evaluate diets because the number of erythrocytes responds more quickly to some dietary deficiencies than does the condition factor or growth rate. High mortalities attributed in part to inadequate diets could be averted by alert biologists who might interpret the observed anemias as indicative of poor nutrition". The effect of dietary inadequacy on the blood picture of fish is well documented. Kamra (1966) described the lowering of blood values in the Atlantic cod (*Gadus morhua*) upon starvation. A severe anemia was produced in coho salmon (*Oncorhynchus kisutch*) fed a folic acid-deficient diet (Smith, 1968). Rainbow trout (*Salmo gairdneri*) which were fed two different

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diets by Barnhart (1969) exhibited different erythrocyte counts and different hematocrit and hemoglobin levels.

Detection of diseases and parasites is an important aspect of fisheries research and management. The effects of diseases and parasites may often pass unnoticed in the early stages of infection, but may be diagnosed hematologically. Smirnova (1964) reported that internal parasites of the bream caused a rise in erythrocyte numbers and hemoglobin content and a reduction in number of leucocytes. Carp (*Cyprinus carpio*) with infectious dropsy showed a decrease in erythrocyte numbers and hemoglobin content with a doubling in leucocyte numbers (Karpenko and Vaslyushko, 1961). Lagler et al. (1961) stated that carp infected with a *Pseudomonas*-sore disease exhibited a drastic lowering of the normal leucocyte, erythrocyte and hemoglobin values. Cardwell and Smith (1971) found that the chinook salmon (*Oncorhynchus tshawytscha*), when infected with vibriosis, exhibited reduced corpuscle counts and hematocrit and hemoglobin levels.

#### USES IN RESEARCH

Hematology has found its way into ichthyological research in a variety of areas. Since blood values are markedly affected by hormones, they are an excellent indicator of physiological response in endocrinology studies as demonstrated by Slicher (1961) and Ball and Slicher (1962). Recently, pesticide pollution of the aquatic environment has received widespread attention. Bouck and Ball (1966) stated that hematology may be a useful tool in monitoring stress levels of aquatic pollution on fish. Henderson et al. (1959) suggested the use of fish bioassay and the physiological response of fish as an analytical tool in identifying toxicants. Likewise, Johnson (1968) suggested the use of fish blood parameters in studies of pesticide toxicity.

Many authors have used blood values in toxicity studies (Eisler, 1967; Eisler and Edmunds, 1966; Ishihara et al., 1967), but few monitored more than two or three parameters. It is suggested here that a full complement of six parameters be employed in bioassay and toxicity studies of fish pesticides. The microhematocrit represents the parameter most often studied, perhaps because it is easily undertaken and easily interpreted. The hematocrit value, however, is not as easily altered as are other parameters and should be used in conjunction with erythrocyte and leucocyte counts, hemoglobin content, osmotic fragility and differential leucocyte counts. Elkin (Johnson, 1968) stated that the possibility that the differential leucocyte count may be affected by pesticides has not been investigated in fish. This parameter may well represent the most definitive test in determining physiological response of fish to toxic substances.

In determining the basic fitness of fish for experimental purposes, Cope (1961) suggested that many observations be made, among them hemotological determinations. Ridgway (1956) stated that, due to their complex intracellular organization, fish erythrocytes may be quite useful in studies of cellular physiology, viruses and rickettsia. Heckman and Brubaker (1970) reported that fish leucocytes are a good chromosome source for cytogenetic studies of fishes.

Probably the most important aspect of the use of fish hematology in research and in practice is the determination of normal values. These normal or nonpathological values must be known in order to recognize the pathological states of being (Hesser, 1960; Hickey, 1970). It must be understood that normal values for laboratory, wild and hatchery-kept fish may differ considerably (McCormick, 1960; Hickey, 1970) due to differing environmental conditions. Excellent basic research on fish blood has been reported by Catton (1951), Saunders (1966) and Snieszko (1961).

#### FACTORS AFFECTING HEMATOLOGICAL VALUES

In experimental work with fish hematology, it has been found that many factors play a role in influencing and altering the values obtained. The sex (Snieszko, 1961), age, size (Banks et al., 1971) and strain of the fish are quite important in this respect. Sexual maturation and spawning will alter values (Yamashita, 1969), probably as a result of hormonal activity. After a period of estivation, the leucocyte count of African lungfish (*Protopterus annectens*) was shown to decrease (Plessis, 1958).

Seasonal differences in blood values due to changing environmental conditions are well reported in the literature. Phillips (1947) suggested that varying levels of dissolved oxygen may alter blood counts. DeWilde and Houston (1967) and Houston and DeWilde (1968) demonstrated that erythrocyte numbers, hemocrit and hemoglobin content are all directly proportional to a rise in temperature in rainbow trout and carp. Salinity-induced variations were reported for the common killifish (*Fundulus heteroclitus*) by Slicher (1961).

Pollution by chromium salts produced significantly higher erythrocyte numbers in rainbow trout from contaminated waters than were found in fish free from such contaminants (Schiffman and Fromm, 1959). Other consequences of pollution have been discussed.

Variations due to changes in pH may also occur, particularly in estuarine and laboratory-held fish. Stevens (1967) reported a change in hemoglobin concentration during periods of exercise in rainbow trout.

Capture methods may greatly influence blood parameters as discussed by Bouck and Ball (1966). Likewise, handling and transportation of

fish from the field to the laboratory may produce changes due to stress. Experimental conditioning and the proper choice of equipment may help to minimize changing parameters due to stress (Slicher et al., 1966). Some cyprinids exhibit changing blood parameters during and after feeding as shown by Smirnova (1965). Inconsistent results may often be attributed to the diluting of blood samples by body fluids during collection. The effects of improper diet, disease and parasites have been discussed.

### CONCLUSIONS

An important use of fish hematology experimentation is to furnish informaton for comparison with the results of other investigators. These comparisons are often difficult due to the lack of standardized techniques and to the omission of descriptions of procedures, controls and experimental conditions by many authors. Hesser (1960) recognized some of these problems and attempted to standardize hematological techniques, as did Larson and Snieszko (1961) and Snieszko (1960). The format established by Cope (1961) for fish toxicity tests can also serve in part as an excellent guideline for fish hematology studies.

Fish hematology is a most useful tool in the hands of the trained ichthyologist. At present it has a wide variety of uses and possesses a challenging future potential. Upon the standardization of techniques, procedures and normal values under varying environmental and laboratory conditions, fish hematology may aid in such areas as distinguishing between populations, identifying aquatic pollutants and the relaying of information on existing and changing environmental conditions. In the field of fish culture, hematology possesses endless uses. Little work has been reported on the hematology of marine species, but, as their importance in aquaculture increases, so will the amount of data.

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## GENERAL NOTES

### THE ATTEMPTED ESTABLISHMENT OF KOREAN RING-NECKED AND JAPANESE GREEN PHEASANTS IN NEW YORK

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The strain of ring-necked pheasant (originally derived from Chinese stock) which has become established in New York State thrives best on high-quality agricultural land, its optimum range in the State being in the Lake Plains region. However, because of urban expansion, as well as other changes in land use and changes in agricultural practices, the amount of good pheasant habitat has diminished considerably in recent years. At the same time, there is much marginal farm land where the species has failed to thrive despite years of stocking game-farm birds and despite efforts to increase overwinter survival by planting winter-food patches.<sup>1</sup> If a hardier species of pheasant could be introduced and become established in such areas, hunting opportunity would be augmented.

In the mid-1960's, information accumulated indicating that the Korean ring-necked pheasant (*Phasianus colchicus karpowi*) or the Japanese green pheasant (*Phasianus versicolor*) might be such a species. Accordingly, as described by Mason (1967), arrangements were made for Department representatives to visit Korea and Japan in the spring of 1965 to procure eggs, and 178 were brought back. Incubation of the eggs and propagation of pogeny were carried on at the Delmar Game Farm. Particular attention was given to maintaining the wild characteristics of the birds, and any breeders that became tame were culled. By 1967, the stock comprised 381 Korean ring-necked pheasants and 480 Japanese green pheasants.

The objectives and guidelines for the stocking program were set forth by Colson (1967). The first experimental stocking was done in the spring of 1968 when 1,248 Korean ring-necked and 112 Japanese green pheasants were released. The corresponding numbers, respectively, were 6,286 and 4,463 in 1969, and 9,150 and 6,477 in 1970-1971. The total numbers released on the various areas used are summarized in Tables 1 and 2. Over 70 per cent of the birds stocked were adults.

As noted by Colson (1967), different parts of the State were used for the liberations of the two species to avoid possible interbreeding. The Korean pheasants were stocked in central and western New York and the Adirondack periphery. The Japanese pheasants were stocked in the Catskill region as well as in the Mohawk and Champlain valleys and east of the Hudson River. The areas in which the birds were liberated are shown in Figures 1 and 2. They represented both areas that were closed to pheasant hunting (for purposes of this experiment) and areas open to pheasant hunting. The number of Korean ring-necked pheasants released totaled 11,787 on 11 areas closed to hunting and 4,897 on 21 areas open to hunting. The corresponding figures for Japanese green pheasants were 6,533 on four areas and 4,519 on 11 areas, respectively.

In the years following the liberations, field surveys were carried on in each area to find the stocked birds or their progeny. In areas closed to hunting, sight observations and crowing-cock counts were made. In areas open to hunting,

<sup>1</sup>Research data had demonstrated that, even on the poorest range where pheasants were being stocked, natural reproduction still produced the majority of the birds harvested and that stocking contributed relatively little to such reproduction. There were also vast areas of the State where, because of unfavorable habitat, pheasant hunting could not be provided or maintained regardless of the degree of stocking with the strain of pheasant being propagated.

TABLE 1. LIBERATIONS OF KOREAN RING-NECKED PHEASANTS IN NEW YORK, 1968-1971\*

| County                           | Area<br>(see Figure 1) | Adult |        |              | Juvenile | Total  |
|----------------------------------|------------------------|-------|--------|--------------|----------|--------|
|                                  |                        | Male  | Female | Un-<br>known |          |        |
| Areas closed to pheasant hunting |                        |       |        |              |          |        |
| Allegany                         | L                      | 306   | 445    | ..           | ..       | 751    |
| Cattaraugus                      | F                      | 182   | 338    | ..           | 227      | 747    |
| Chautauqua                       | D                      | ..    | ..     | ..           | 600      | 600    |
| Chemung-Schuyler                 | M                      | ..    | ..     | ..           | 600      | 600    |
| Chenango                         | R                      | 434   | 500    | ..           | ..       | 934    |
| Franklin                         | Z                      | 506   | 1,198  | ..           | ..       | 1,704  |
| Jefferson                        | U                      | 471   | 942    | ..           | 590      | 2,003  |
| Oswego                           | S                      | ..    | ..     | ..           | 600      | 600    |
| St. Lawrence                     | X                      | 17    | 17     | ..           | ..       | 34     |
| Tioga                            | O                      | 395   | 475    | ..           | ..       | 870    |
| Wyoming                          | B                      | 698   | 1,346  | ..           | 900      | 2,944  |
| Sub-total                        |                        | 3,009 | 5,261  | ..           | 3,517    | 11,787 |
| Areas open to pheasant hunting   |                        |       |        |              |          |        |
| Allegany                         | K                      | 106   | ..     | ..           | ..       | 106    |
| Broome-Tompkins-<br>Cortland     | P                      | ..    | ..     | ..           | 1,200    | 1,200  |
| Cattaraugus                      | E,G,H,I,J              | 384   | ..     | 56           | ..       | 440    |
| Chautauqua                       | C                      | 23    | 150    | ..           | ..       | 173    |
| Chenango                         | Q                      | 225   | ..     | ..           | ..       | 225    |
| Essex                            | Y                      | 410   | ..     | ..           | ..       | 410    |
| Franklin                         | Za                     | 150   | ..     | ..           | ..       | 150    |
| Jefferson                        | T,Ta-Te                | 1,384 | 146    | ..           | ..       | 1,530  |
| St. Lawrence                     | V,W                    | 115   | ..     | ..           | ..       | 115    |
| Seneca                           | A                      | 224   | 99     | ..           | ..       | 323    |
| Tioga                            | N                      | 225   | ..     | ..           | ..       | 225    |
| Sub-total                        |                        | 3,246 | 395    | 56           | 1,200    | 4,897  |
| Total                            |                        | 6,255 | 5,656  | 56           | 4,717    | 16,684 |

\* From Hauber (1972).

hunter bag checks were made. By 1974, however, all the liberations had been designated "unqualified failures" except for those on three closed areas, i.e., Area Z in Franklin County where Korean ring-necked pheasants had been released and Area K in Dutchess County and Area N on the border between Ulster and Orange Counties where Japanese green pheasants had been released. "Unqualified failure" meant that no birds of the species liberated were found or that the number was too few to offer any prospect of a population that would support a trap and transfer program.

Areas K and N were opened to hunting in the fall of 1974, and efforts were made (50 hours and 200 hours on the two areas, respectively) to locate and interview hunters. Only three hunters were located on Area K and were found to have taken four male New York ring-necked pheasants but no Japanese pheasants. On Area N, 35 hunters were interviewed and had taken four male New York ring-necked pheasants, one male Japanese pheasant, eight male hybrid pheasants and one female pheasant of unknown species. The liberations on these areas are now considered "unqualified failures" also. Not only had the Japanese pheasants virtually disappeared, but New York ring-necked pheasants were plentiful and hybridization had been demonstrated.

Area Z was not opened to hunting in 1974. Instead, a winter trapping program was undertaken to catch and identify the stock of the area. Two male



Figure 1. Areas where Korean ring-necked pheasants were liberated in New York, 1968-1971.

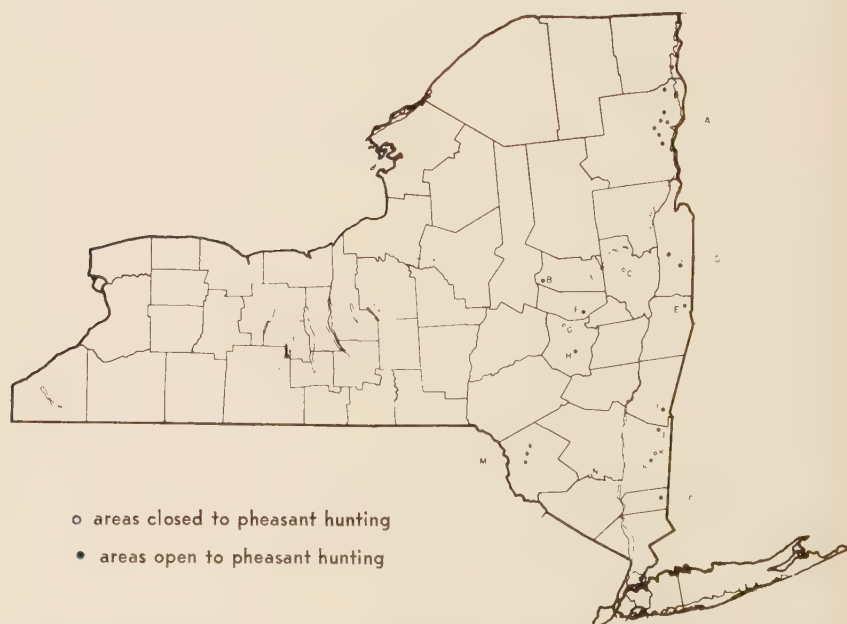


Figure 2. Areas where Japanese green pheasants were liberated in New York, 1968-1971.

TABLE 2. LIBERATIONS OF JAPANESE GREEN PHEASANTS IN NEW YORK, 1968-1971\*

| County                           | Area<br>(see Figure 2) | Adult |        |              | Juvenile | Total  |
|----------------------------------|------------------------|-------|--------|--------------|----------|--------|
|                                  |                        | Male  | Female | Un-<br>known |          |        |
| Areas closed to pheasant hunting |                        |       |        |              |          |        |
| Dutchess                         | K                      | 240   | 432    | ..           | 375      | 1,047  |
| Saratoga                         | C                      | 583   | 1,067  | ..           | 375      | 2,025  |
| Schoharie                        | G                      | 663   | 881    | ..           | 756      | 2,300  |
| Ulster-Orange                    | N                      | 279   | 507    | ..           | 375      | 1,161  |
| Sub-total                        |                        | 1,765 | 2,887  | ..           | 1,881    | 6,533  |
| Areas open to pheasant hunting   |                        |       |        |              |          |        |
| Columbia                         | I                      | ..    | ..     | 285          | ..       | 285    |
| Dutchess                         | J, L                   | 48    | ..     | 70           | ..       | 118    |
| Essex                            | A                      | 150   | 300    | ..           | 750      | 1,200  |
| Fulton                           | B                      | 177   | 75     | ..           | 375      | 627    |
| Montgomery                       | F                      | 469   | 300    | ..           | ..       | 769    |
| Putnam                           | O                      | 146   | 51     | ..           | ..       | 197    |
| Rensselaer                       | E                      | ..    | ..     | 312          | ..       | 312    |
| Schoharie                        | H                      | ..    | ..     | 102          | ..       | 102    |
| Sullivan                         | M                      | 382   | 431    | ..           | ..       | 813    |
| Washington                       | D                      | 96    | ..     | ..           | ..       | 96     |
| Sub-total                        |                        | 1,468 | 1,157  | 769          | 1,125    | 4,519  |
| Total                            |                        | 3,233 | 4,044  | 769          | 3,006    | 11,052 |

\* From Hauber (1972).

and one female Korean ring-necked pheasants, as well as three females of uncertain species, were taken. No New York ring-necked pheasants were caught. In the spring of 1975, counts along 64 miles of highway revealed 62 crowing cocks. Apparently, a breeding population of Korean pheasants persisted on this area, and consequently, the prohibition of pheasant hunting there was continued.

All propagation of Korean ring-necked and Japanese green pheasants for experimental liberation in the wild was discontinued in 1971, although a few birds of each species continued to be maintained on a game farm for display purposes. As pointed out by Colson (1967), it was never contemplated that these pheasants would be propagated on a game farm over an extended period of years. Rather, the role of the game farm was to provide birds for stocking selected test areas for a maximum of three consecutive years each. It was hoped that in many of these areas wild populations would become established and increase to a level that would support a trap and transfer program to extend their range to other suitable habitats. Unfortunately, except for the one locality in Franklin County, the undertaking failed although a few of these pheasants may be encountered for a time elsewhere. Further observation will be needed to determine the outcome in Franklin County.

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THE NEED FOR STANDARDIZATION IN PRE- AND POST-  
OPERATIONAL ECOLOGICAL SURVEYS<sup>1</sup>

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The purposes of a pre-operational ecological survey with respect to an industrial facility are generally (1) to provide the data bank required as a baseline for post-operational studies to measure the extent of environmental impact following on-line operations of the facility and (2) to project the potential impact on the biota prior to such operations. Post-operational studies, duplicating the pre-operational surveys, should be designed so that the two sets of data will be as comparable as possible.

The scientific community – acting as a buffer between industry, government and the public – must provide the contracting industry with impartial and accurate data while acting as a disinterested third party to any litigation between industry, regulatory agencies and certified conservation groups. Inasmuch as the industry in question is often required by law to fund the necessary surveys, the scientist often finds himself branded as “bought by industry”, an accusation that, unfortunately, has occasionally been justified.

The most difficult role of all those involved, however, is that of the governmental biologist. In most cases involving marine studies he is a career fishery or aquatic biologist who is well versed in his field but now suddenly finds himself acting as an environmental referee between industry and the ecologically-aware public. He is expected to be familiar with the terminology of litigation and industrial engineering. He hears about certificates of environmental compatibility, diffuser systems, impingement, heat dissipation models, nanograms, etc. and finds that any casual remark made in a public hearing may be quoted by the media. He is caught between his responsibility for conservation and resource management and the need for increased industrial production and sources of energy. In the end, he may find that his recommendations are ignored if the political power of an industry exceeds that of the governmental agency he represents.

Certainly one way to reduce personal or industrial bias in the results of a study and to arm the state and federal agencies charged with the job of environmental referee is to provide a sound data bank of known history, methodology and standardized quality control. All too often the results of a pre-operational investigation cannot be used because the post-operational study was conducted using a different methodology (e.g., different mesh size in plankton nets or different trawl configurations). At times, the investigator cannot undertake a meaningful survey because the level of funding is insufficient for hiring personnel and purchasing necessary equipment or the lead-in time allows little or no opportunity for gear testing. In some instances, sampling is hampered by the oceanographic conditions or coastal morphology.

Many of these problems could be eliminated, however, if the methodology of data collection and analysis were standardized, not only between pre- and post-operational surveys but also between geographic regions and target species. Following are several suggestions for standardizing such work.

Geologists have classified most potential environments to be encountered in a survey (e.g., sandy beach, rocky shore, mud bottom, etc.). The general types of gear that can or cannot be used in each situation are fairly well agreed upon. For example, a beach seine works fine on a sandy beach but obviously not on a rocky one. Trawls, seines and traps generally come in somewhat standard

<sup>1</sup>Contribution No. 31 of the New York Ocean Science Laboratory. It is derived from a paper presented at the 1973 Northeast Fish and Wildlife Conference, Mt. Snow, Vt. The author wishes to acknowledge Albert C. Jensen of the New York State Department of Environmental Conservation and Edward Mulvihill of the Long Island Lighting Co. for their comments and discussion.

<sup>2</sup>Present affiliation: Oceanographic Services Office (EM3), National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Rockville, Maryland 20852.

shapes and sizes. What is not standard is the number of floats or leads on a seine, the method of setting a seine (by hand or from a boat), the length of warp or door configuration on trawls, towing speeds and mesh sizes.

In the Northeast, surveys in marine waters are generally directed toward the same target species, i.e., striped bass, bluefish, menhaden, silversides and winter flounder which are common to the region from Cape Hatteras to Cape Cod. Why not, then, adopt a standardized collection and analysis format? For example, standardize the mesh size and floatation configuration of gill nets so that catch data for striped bass or menhaden at Davids Island in New York can be compared with those for the same species at Morgantown Station in Maryland or the Cape Cod Canal in Massachusetts. Fine-mesh seines could be standardized so that the number of floats and leads, mesh size, length of warp and method of setting would be the same everywhere, allowing a direct comparison of the catch data for silversides, for example, between various studies.

Plankton collections should be even easier to standardize since bottom topography does not generally interfere with operations to the same extent as it does in trawling or seining. Standardization of net diameter, mesh size, tow length and speed, preservative and buffers is dictated in part by the target biota. Certainly the ichthyoplankton are a problem common to all site surveys. Such mutual target taxa could well be a common meeting place for a single, standard ichthyoplankton net. Such accord has been possible between nations during international surveys.

It would be desirable to standardize the measurements to be made on samples. Scale radii are a fine measurement of age in the scup or fluke, but certainly not in the red hake or silver hake where otoliths must be read. Changes in the

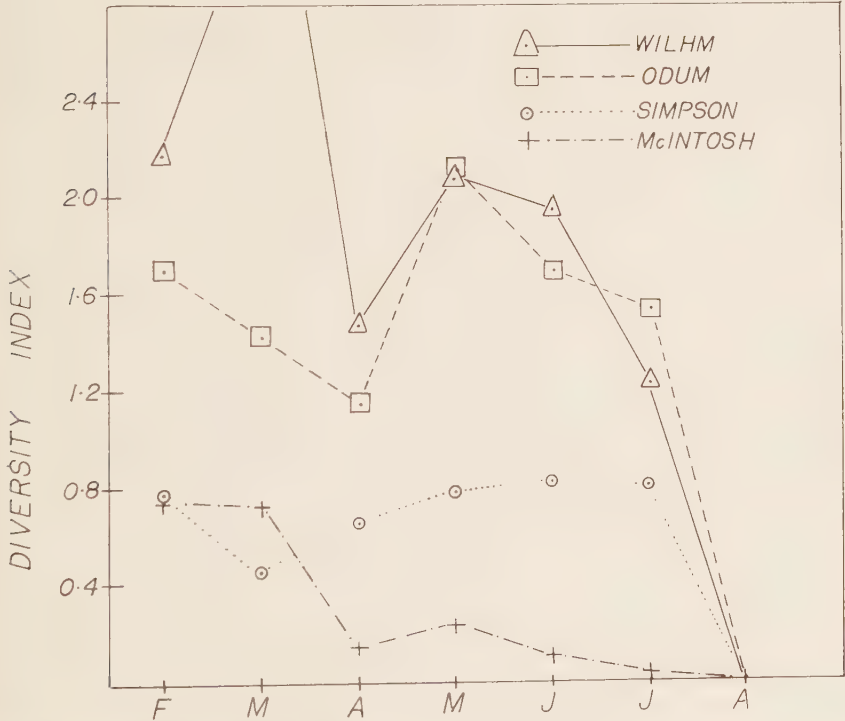


Figure 1. Seasonal changes in various species-diversity indices for fish impinging on the travelling screens at a power-generating facility on Long Island Sound.

modal sizes of year classes allow an estimation of empirical growth and, hence, age; but this often requires a large sample, and many older fish (e.g., among menhaden) cannot be aged or assessed for growth in this manner.

Methods of data management and analysis also need to be standardized. Several types of analyses are common, however, to all or most investigations, but the actual results depend upon the methods and data format. For example, what is a statistically representative sample size? Should stomach content analyses be by weight or by volume? Should gonads be analyzed by volume, weight or ovum diameter? If by volume or weight, what type of gonad index should be used? Should population estimates be made of abundance, number of fish or biomass? For certain species, perhaps, specific analyses are dictated; if so, this could be instituted for the geographically and economically or ecologically common species such as striped bass, menhaden and silversides.

Several analyses using various indices are standard, but the formulae are not. Condition factors, diversity indices, gonad indices, and mortality and population estimates may be derived by various mathematical methods. Inasmuch as pre- and post-operational surveys are designed with the same basic goals regardless of geographic, oceanographic, industrial or political differences, a common method of analysis is a paramount need. There is a plethora of diversity indices. Based on the same set of data, different formulae can produce different trends. An example is shown in the accompanying illustration, using the indices of MacIntosh (1967), Odum (1971), Simpson (1949) and Wilhm (1967). Here the data represent the fish impinged on the travelling wash screens at a power-generation facility on Long Island Sound. Note how, in March, one index (Wilhm) goes up, whereas two (Odum and Simpson) go down. Then in April, one (Simpson) goes up and three (Wilhm, Odum and MacIntosh) go down.

During pre-operational surveys, sampling locations must include control and experimental sites. Similarly, control data are needed in post-operational studies. Also, sampling frequency should be dictated by an oceanographic calendar rather than the Gregorian calendar. For example, sampling should be conducted when seasonal temperatures reach natural maxima and minima; "spring" and "fall" conditions should be designated by natural seasonal changes in temperature or salinity. Sampling should also be conducted during periods of maximum biological or chemical change, which may be at different times of the year in, for instance, the eastern and western ends of Long Island Sound.

Such standardization of collecting and analyzing techniques would assure data of known quality and history as a basis for interpretation and would improve the relevance of information provided to state agencies and others involved in formulating regulatory guidelines and issuing permits.

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## SPONTANEOUS AND EXPERIMENTAL TRANSFER OF SARCOPTIC MANGE MITES FROM RED FOXES TO HUMANS

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In July 1970, an 8-year-old girl from Chemung County (N.Y.) developed a dermatitis of the chest after handling a mangy pet red fox (*Vulpes fulva*) pup. In September of the same year, two trappers developed similar skin lesions after handling mangy red foxes. In November 1970, the senior author and a fish and wildlife technician attempted to experimentally infest their hands and arms with sarcoptic mites from mangy red foxes.

Scrapings from the chest of the young girl were found by a dermatologist to contain *Sarcoptes scabiei* mites. It seemed that she had acquired the infestation from her mangy pet red fox pup which she had been frequently playing with and holding. Sarcoptic mange was confirmed in the pet fox through skin scrapings mounted in Hoyer's solution and examined by the senior author. Lindquist and Cash (1973) reported that four of six people in contact with a domestic kitten infested with *Sarcoptes* sp. mites developed skin lesions which disappeared after treatment with proprietary ectoparasiticides.

In the authors' experimental infestation of humans, skin lesions developed on the senior author, but not on the fish and wildlife technician. In this case, as well as that involving the two trappers, skin scrapings were taken, and sarcoptic mites were considered to be the etiological agents. However, this diagnosis was unconfirmed since, upon microscopic examination, the scrapings did not reveal any sarcoptic mites, although all the humans except the technician had papules characteristic of early stages of sarcoptic mange as described by Theobald (1940). Mites placed on the skin of the senior author were observed under a binocular dissecting microscope to burrow into the epidermis. Mites on the technician made no attempt to penetrate the skin. These observations lead the authors to conclude that individual susceptibilities to sarcoptic mite infestations vary.

Mange mites infesting wild red foxes and wild canids were successfully transmitted to captive red foxes, wild canids, dogs and gray foxes (*Urocyon cinereoargenteus*) as reported by Stone (1972). The transitory dermatitis which developed in the gray foxes, on which thousands of mites were placed, differed from the condition observed in the human subjects of the present case in that the mites were not reproducing in the human hosts' tissues. The skin lesions of the senior author cleared up within approximately 2 weeks. This finding further substantiates the idea that sarcoptic mites do not reproduce well in man, since the life span of a female mite is from 8 to 17 days (Faust and Russell, 1964). The mange mites of red foxes, which were readily interchanged among red foxes, dogs, wild canids and, in the present instance, humans, were of the species *Sarcoptes scabiei* var. *canis*.

Zeh (1974) reported sarcoptic mite densities as high as 1,877 per square centimeter of epidermis on severely infested red foxes with a potential range in the millions for a single animal. In view of these figures, it is not difficult to see how a transitory dermatitis could develop, even in a relatively non-susceptible host such as man, when the subject is exposed to mangy pelts or animals.

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# A GREATER AMBERJACK FROM NEW YORK WATERS<sup>1</sup>

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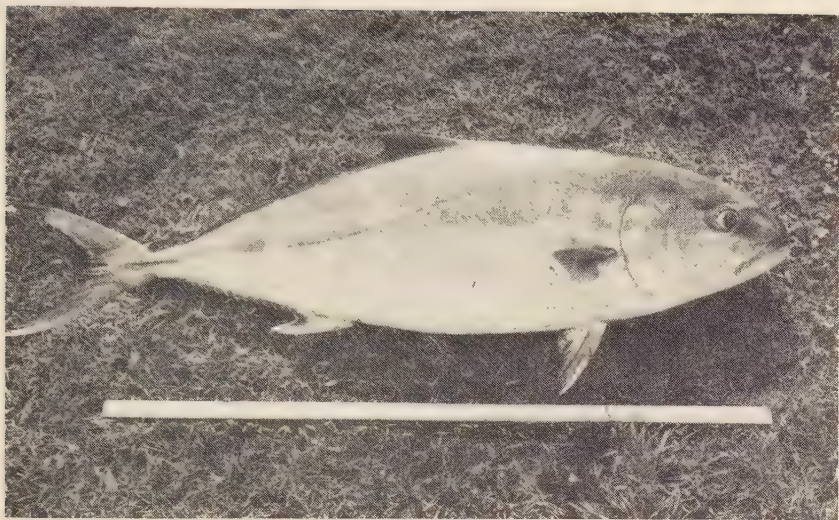
Bradley Loewen East Hampton Town Seafood Producers  
Cooperative, Inc.  
East Hampton, New York

The greater amberjack (*Seriola dumerili*) is known from both sides of the Atlantic Ocean. In the western Atlantic, it ranges from New England to Brazil, including the Gulf of Mexico (Böhlke and Chaplin, 1968), but it is a straggler to New Jersey and northward (Nichols and Breder, 1926; Breder, 1948). This species is the largest of the Atlantic amberjacks, reaching a length of 5 to 6 feet, and is the most important to sport fishermen.

Its occurrence in New York waters was described as "accidental" by Nichols (1913) and as "casual" by Nichols and Breder (1926). It was not listed by Breder (1938), Greeley (1939) or Gordon (1951). The only previous New York record of a fish believed to be of this species was a specimen weighing 13 pounds 1½ ounces that was caught in Gravesend Bay on July 15, 1896 (Bean, 1901). In discussing the occurrence of carangid fishes on Long Island, Alperin (1967) noted the greater amberjack as being "infrequently taken by anglers; trolling offshore". He also gave the general size range as 375-650 millimeters.

<sup>1</sup>Contribution No. 45 of the New York Ocean Science Laboratory. The authors wish to acknowledge the advice of Dr. Herbert M. Austin and the photography of Carl O. Mamay.

<sup>2</sup>Present affiliation: U.S. Nuclear Regulatory Commission, Environmental Specialist Branch, Washington, D.C. 20555.



Female greater amberjack (*Seriola dumerili*) caught in Gardiner's Bay near East Hampton, New York, in October 1974.

On October 6, 1974, a greater amberjack was captured in a pound net in Gardiner's Bay near the entrance to Three Mile Harbor. It measured 115 centimeters (45.3 inches) in fork length and 131 centimeters (51.6 inches) in total length, and weighed 26.22 kilograms (57.75 pounds). It was a female with a total gonad weight of 132.5 grams (0.29 pound) which was 0.51 per cent of the body weight. The stomach was empty. Aging by the scale method was difficult, but the fish appeared to be 8 to 10 years old. So far as the authors are aware, this specimen constitutes the first conclusive record of the species from New York waters.

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# TARPON FROM MONTAUK, NEW YORK<sup>1</sup>

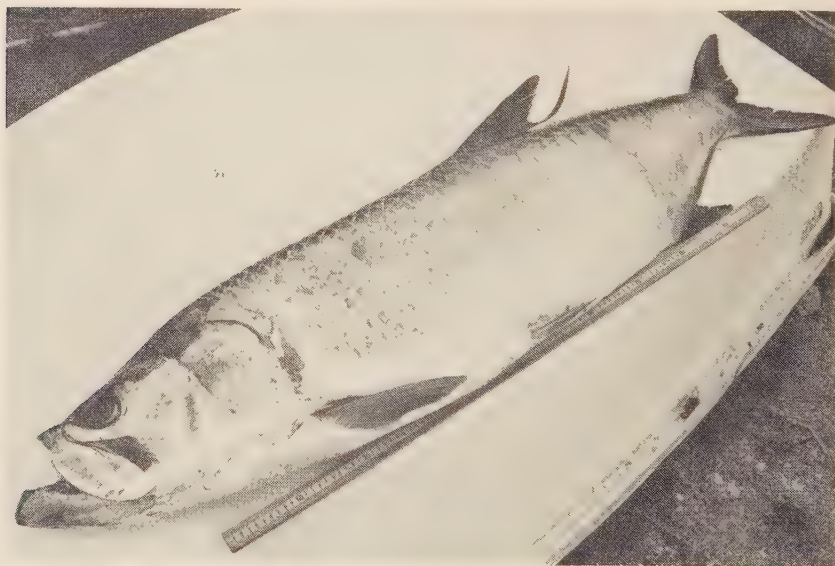
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Tarpon (*Megalops atlantica*) range from Nova Scotia to Brazil, including the Gulf of Mexico and Central America. However, they are taken only occasionally north of North Carolina. Their primary habitat is in fresh to brackish tropical coastal waters (Böhlke and Chaplin, 1970). The only other member of the family to which the tarpon belongs (Elopidae) that is found in the western Atlantic is the ladyfish (*Elops saurus*) which is also of southern faunal origins (Böhlke and Chaplin, 1970) although it has been reported from Long Island waters by Latham (1918, 1920) and Hickey et al. (1975).

Tarpon have been reported from the marine waters of New York and vicinity and are probably more common than the records indicate. At the western end



Male tarpon (*Megalops atlantica*) caught in Fort Pond Bay at Montauk, New York, in July 1974.

<sup>1</sup>Contribution No. 43 of the New York Ocean Science Laboratory. The authors wish to acknowledge the advice of Dr. Herbert M. Austin, the photographs of Carl O. Mamay and the cooperation of commercial fishermen Dominic Grace, Kevin Miller, Nick Havens, Paul Lester, William Lester and Joe Olszewski.

<sup>2</sup>Present affiliation: U.S. Nuclear Regulatory Commission, Environmental Specialist Branch, Washington, D.C. 20555.

of Long Island, they have been taken in Sandy Hook Bay (Breder, 1925; Breder and Redmond, 1929) and in New York Harbor (Breder and Nigrelli, 1939). Eastward, they have been reported from Patchogue on the south shore (Bean, 1903) and from Southold Bay (Nichols and Breder, 1926) and Orient (Latham, 1923) on the north shore. Latham's report, of a tarpon taken in 1922, was the last for Long Island, and the absence of reports since then probably reflects the lack of investigations. However, in 1974, two tarpon were taken at Montauk at the eastern end of the Island. Both were larger than any of those previously reported.

The first was captured on July 14 in a pound net in Fort Pond Bay (water temperature, 21.7° C.) The fish leaped and thrashed violently and finally exhausted itself after becoming entangled in the funnel of the net. It measured 143 centimeters (56 inches) in fork length and 160 centimeters (63 inches) in total length and weighed 29.06 kilograms (64 pounds). The fish was a running ripe male with a total gonad weight of 630 grams (1.39 pounds) which was 2.17 per cent of the body weight. The stomach contained one small (about 100 millimeters) partially digested fish, probably a young-of-the-year scup (*Stenotomus chrysops*). As Gordon (1951) noted the status of tarpon in Block Island Sound as "unrecorded," this is the first confirmed record from that area.

The second tarpon was captured on August 26 in a haul seine on the ocean beach at Montauk (water temperature, 23.3° C.). As it was possible to release the fish alive, only length and weight data were recorded. These were 131 centimeters (51 inches) in fork length and 25.88 kilograms (57 pounds) respectively.

The fate, in northern latitudes, of fish of southern origins is uncertain, but it is not uncommon for them to be found dead or stressed after the onset of cool weather (Alperin, 1967; Hickey et al., 1975). Galloway (1941) reported the death of many fish, including tarpon, at Key West, Florida, when the winter water temperature dropped to 13.9° C.

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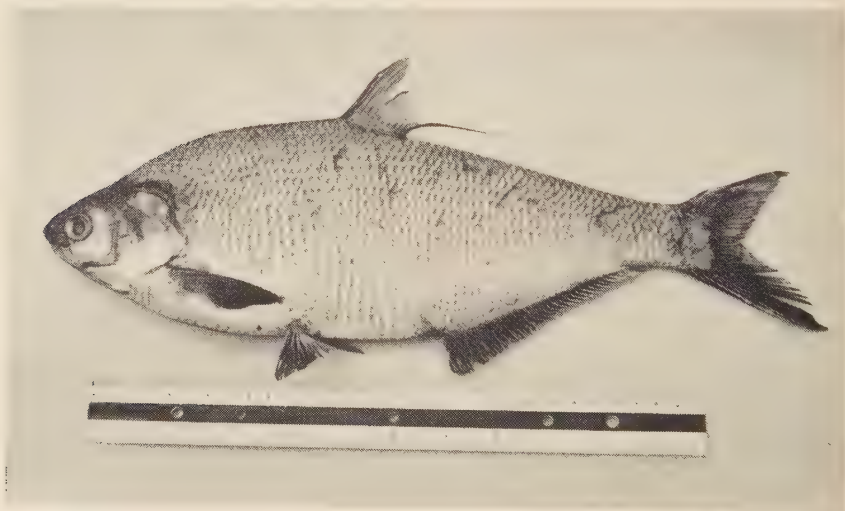
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FIRST RECORD OF THE GIZZARD SHAD FROM  
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The gizzard shad (*Dorosoma cepedianum*) occurs as a common freshwater species from Minnesota to the St. Lawrence River (Eddy, 1957) and as a brackish-water species from Cape Cod to Mexico (Breder, 1948). It has been introduced as a forage fish into many areas of the central and eastern United States (Herald, 1972) and is landlocked in many lakes and ponds (Hildebrand and Schroeder, 1972). The gizzard shad (Family Dorosomidae) is more a species of freshwater habitats than are the true shad and herrings (Clupeidae), and, although it occurs in brackish water, it is rarely found in marine habitats (Hildebrand and Schroeder, 1972). Bean (1903) recorded its distribution in New York as including the Great Lakes and Ohio Basin only. It was not reported from Long Island's fresh waters by Greeley (1939b) or Senning (1939), and it was not reported from New York's marine waters by Bean (1901, 1903), Nichols and Breder (1926), Greeley (1939a) or Gordon (1951). The only report of this species from marine waters near New York is that of Breder and Nigrelli (1934) who described two specimens each about 1 foot long taken in a pound net in Sandy Hook Bay (N.J.) during October 1933. That record was the first from



Male gizzard shad (*Dorosoma cepedianum*) caught in Northwest Harbor near East Hampton, New York, in May 1974.

<sup>1</sup>Contribution No. 44 of the New York Ocean Science Laboratory. The authors wish to acknowledge the advice and comments of Dr. Herbert M. Austin and the photography of Carl O. Mamay.

<sup>2</sup>Present affiliation: U.S. Nuclear Regulatory Commission, Environmental Specialist Branch, Washington, D.C. 20555.

Sandy Hook Bay as well as the first from the northern sector of the New York Bight (Montauk Point, N.Y. to Cape May, N.J.).

On May 20, 1974, a gizzard shad was captured by the second author in a pound net in Northwest Harbor which is in the Shelter Island-Gardiner's Bay area of the south fork of eastern Long Island, New York. Salinity levels in this area are typically 26—28 ppt. The fish was a male weighing 755 grams (1.6 pounds). It measured 325 millimeters in standard length, 358 millimeters in fork length and 407 millimeters (16 inches) in total length. Aging by the scale method was difficult, but the fish appeared to be 6 to 7 years old. The gonads were large (14.97 grams) and ripening, and they accounted for 1.98 percent of the body weight. Heldebrand and Schroeder (1972) described the spawning season as early summer. It is believed that this constitutes the first record of a gizzard shad from Long Island as well as the first from the marine waters of New York.

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A TAIL TAG FOR MARKING BEAVER<sup>1</sup>

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A permanent, inexpensive and effective method of marking live beaver has long been sought. With a relatively high number of nuisance animals being handled in the Adirondack region and data from a regional survey of beaver being collected each year, a system of identification was necessary. Various methods of ear or webb tagging left something to be desired and were not suitable for the purposes involved. Two different designs for a tail tag were sent to a commercial tag manufacturer, but the company was unable to supply either of these due to certain government regulations. Therefore, wildlife personnel trapping nuisance beaver in Region 5N developed the following method of marking.

Figure 1 illustrates the tag parts which consist of one brass bolt 2 inches long by  $\frac{1}{8}$  inch in diameter having 32 threads per inch (6 x 32), together with accompanying nut and two copper washers  $\frac{1}{2}$  inch in diameter with a  $\frac{3}{16}$ -inch center hole. The washers are hand stamped using  $\frac{1}{16}$ -inch metal letter and number dies. Each washer is inscribed on one side only—one: N.Y.S.D.E.C. (plus a serial number); the other: Ray Brook (plus the same number).

Figure 2 shows the tag in place. To accomplish this, the tail is pierced with a common ice pick having a diameter slightly larger than the bolt and cleaned with hydrogen peroxide. It has been found that the best location to apply the tag is 2 to 3 inches from the hair line and a little to the right or left of the tail

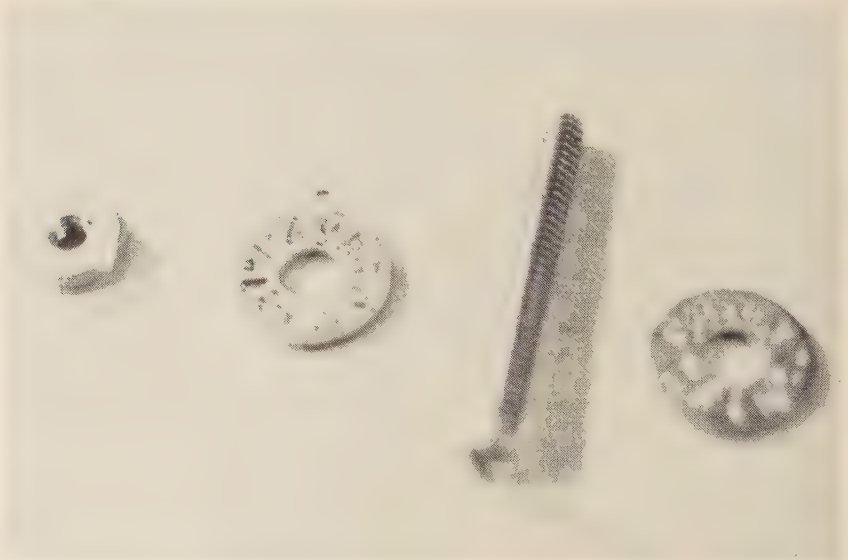


Figure 1. Components of tail tag for marking beaver.

<sup>1</sup>A contribution of Federal Aid in Fish and Wildlife Restoration Project W-130-D. The photographs were made by Robert Rehbaum of the N.Y.S. Department of Environmental Conservation.

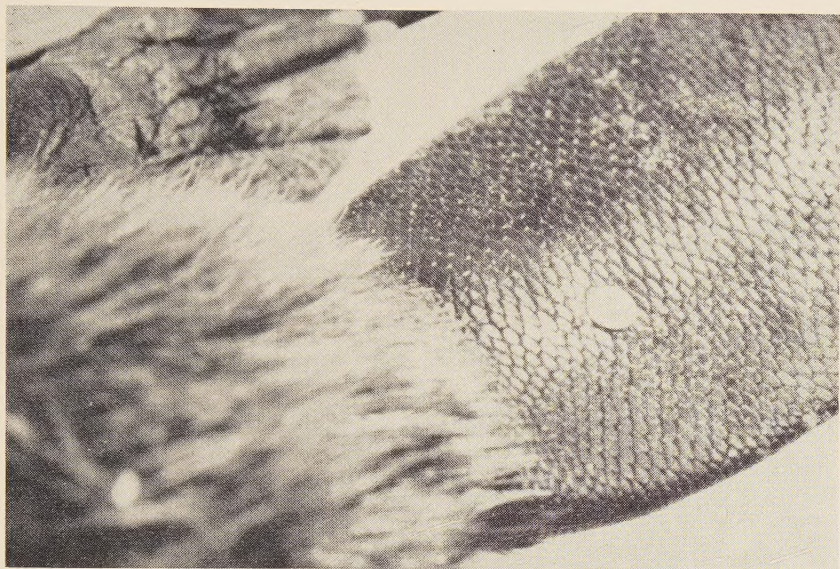


Figure 2. Tag in place on tail of a beaver.

keel. One washer is placed on the bolt and inserted through the tail from either the dorsal or ventral side whichever is easier for the individual tagger. The remaining washer is then installed on the bolt and secured with the brass nut. The nut must be drawn up to the point of a tight squeeze. Excess bolt is cut off with side cutters leaving approximately three threads which are then crimped to prevent the nut from coming free.

The beaver's tail is a storage facility for fat and has very little, if any, feeling. Of all the specimens tagged, none showed any sign of pain or struggle, and bleeding was not noticeable. The first 18 beaver tagged were held in captivity for a minimum of 24 hours and some for 4 days. During this time they neither showed any signs of discomfort nor made any attempt to remove the tag. This included beaver from the same family held in one enclosure.

The tagging process can be performed by one man, although large beaver are sometimes difficult to handle. A few of the larger beaver have been tagged farther down on the tail, but on recapture the tags have shown a little wear. On all recaptures, the printing on the copper washers has shown up black and extremely visible. All recaptured beaver have shown no ill effects from the tag, and their tails have completely healed from the ice pick punctures. It is very important to secure the tag tightly on the tail, allowing no play which would cause wear and movement of the bolt within the tail. Small young-of-the-year beaver have been tagged and recaptured with no evidence of deformity as growth occurred. Several adult beaver have been recaptured after tags had been in place for 18 months with no abnormalities.

The author and other personnel involved with this procedure believe that the method is very satisfactory. However, information for longer periods following tagging will be necessary to fully assess the method.

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